



## Debate: Percutaneous revascularization strategies for distal left main coronary artery disease. Approach from the DKCRUSH-V trial



*A debate: Estrategias de revascularización percutánea para la enfermedad del tronco común distal.  
Abordaje desde la perspectiva del DKCRUSH-V*

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**QUESTION:** What aspects do you think might explain the significant differences reported between the results from the EBC MAIN (European bifurcation club left main coronary stent study),<sup>1</sup> and the DKCRUSH-V (Double kissing crush vs provisional stenting for left main distal bifurcation lesions) clinical trials?<sup>2</sup>

**ANSWER:** The EBC MAIN trial has proven the non-inferiority of the step-by-step provisional stenting technique approach compared to the early double stenting strategy in 467 patients with distal left main coronary artery bifurcation disease (Medina 1,1,1 or 0,1,1). No significant differences were reported regarding the overall rate of major adverse cardiovascular events, target lesion failure, acute myocardial infarction, and stent thrombosis.<sup>1</sup>

On the other hand, the DKCRUSH V trial randomized 482 patients with distal left main coronary artery bifurcation disease (Medina 1,1,1 or 0,1,1) to receive treatment with the provisional technique vs the DK-crush technique. The latter had a lower rate of major adverse cardiovascular events with statistically significant differences regarding target lesion failure (10.7% vs 5%) [hazard ratio, 0.42; 95% confidence interval, 0.21-0.85;  $P = .02$ ], acute myocardial infarction (2.9% vs 0.4%;  $P = .03$ ), and stent thrombosis (3.3% vs 0.4%;  $P = .02$ ) at 1-year follow-up.<sup>2</sup> Results were better in the most complex coronary bifurcation lesions defined, above all, as those with greater side branch damage ( $> 70\%$  of stenosis and  $> 10$  mm of lesion length), severe calcification or well-defined angles ( $> 70$  or  $< 45^\circ$ ).

Some have tried to compare data from the EBC MAIN to data from the DKCRUSH-V. However, there are aspects that just don't make them comparable trials for study design reasons or for the overall results of the DK-crush technique: the complexity of bifurcation and the degree of damage to the side branch was lower in the EBC MAIN compared to the DKCRUSH-V defined by severity of stenosis  $> 70\%$  and length  $> 10$  mm. As a matter of fact, the mean side branch lesion length was 7 mm in the EBC MAIN vs 16 mm in the DKCRUSH-V, which can be seen in the rate of double stenting of the provisional group (22% in the EBC-MAIN vs 47% in the DKCRUSH-V). Similarly, the low rate of double stenting of the

provisional group was left to the operator's criterion allowing residual lesion in the ostial left circumflex artery of 90% vs 75% in the DKCRUSH-V. In my opinion, another factor penalizing the double stenting group is that only 5% of the patients were treated with the DK-crush technique since the most widely used ones were the culotte (53%), and the T or TAP (T and protrusion) techniques (33%). Also, 6% of the patients from the double stenting group could not receive the second stent unlike the DKCRUSH-V trial where the procedural success of the DK-crush group was 100%. The use of imaging modalities in both studies was similar in around 40% of the cases.<sup>3</sup>

**Q.:** In the light of the evidence available and based on your own experience, when do you recommend provisional stenting and when an early double stenting technique to treat distal left main coronary artery stenoses?

**A.:** Obviously, the only lesions eligible for 2-stent implantation into the distal left main coronary artery are those found in bifurcations we call complex or true bifurcations, that is, when both left main coronary artery branches are damaged (Medina 1,1,1 or 0,1,1). However, among these lesions, the complexity of left main coronary artery bifurcation lesions depends on many different factors, among them, the DEFINITION II trial criteria are the most widely used of all. As far as I know, they're the most important ones of all regarding the selection of the bifurcation technique that will eventually be used: simple or complex (left main coronary artery bifurcation with side branch stenosis  $> 70\%$  and lengths  $> 10$  mm, moderate-to-severe calcifications, bifurcation angles  $< 45^\circ$  or  $> 70^\circ$ , multiple lesions, main vessel reference diameters  $> 2.5$  mm, main vessel lesion lengths  $> 25$  mm or presence of thrombus in the lesion).<sup>4</sup>

This trial proved that complex bifurcations, under these criteria, are associated with fewer events if treated with the complex double stenting technique compared to the provisional stenting technique. In my opinion, the most valuable criteria that should be used when having to decide between provisional or complex stenting techniques—rather than the severity of stenosis in the side branch—are

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side branch lesion lengths > 10 mm, moderate-to-severe calcifications, and bifurcation angles < 45°. Angles > 70° can be solved much easier using the provisional 1-stent technique with minimal protrusion in bailout T or TAP.

**Q.:** In how many angioplasties performed on the distal left main coronary artery is the double stenting technique often used?

**A.:** Provisional stenting technique used systematically is valid to treat most distal left main coronary artery disease including true bifurcations with side branch damage, assuming that 20% to 40% of the patients will end up with a second stent in the side branch. At our center, however, there are patients we directly treat with 2 stents for being high-complexity patients. The rate of left main coronary artery true bifurcations is somewhere between 25% and 30%.

**Q.:** What is your favorite double stenting technique in the distal left main coronary artery and why?

**A.:** I'd say scientific evidence is rather clear on what the double stenting technique of choice should be to treat complex distal left main coronary arteries. In addition to the aforementioned results from the DKCRUSH-V and the DEFINITION II trials where 77.8% of the patients treated with 2 stents received the DK-crush technique,<sup>1,4</sup> 2 meta-analyses recently published have confirmed the superiority of the DK-crush technique vs other bifurcation techniques. In the one conducted by Di Gioia et al.<sup>5</sup> of a total of 5711 patients, 5 different bifurcation techniques used in the studies were compared (provisional stenting, T-stent, TAP, crush, culotte, and DK-crush). It was found that patients treated with the DK-crush technique had lower rates of major adverse cardiovascular events, significant differences regarding the need for new target lesion revascularization (odds ratio, 0.36; 95% confidence interval, 0.22-0.57), and no differences regarding cardiac death, myocardial infarction or stent thrombosis. The biggest clinical benefits from using the DK-crush technique were reported in lesions with side branch disease > 10 mm in length, that is, the most complex bifurcations of all. The second meta-analysis conducted this year by Park et al.<sup>6</sup> after the publication of the EBC MAIN results—with a total of 8318 patients—reached the same conclusions. In the conventional meta-analysis, the DK-crush technique proves non-superior to the provisional stenting technique except for cases with side branch disease and lengths > 10 mm where there is a lower rate of cardiac death, and target vessel revascularization. However, when a multiple comparison analysis was conducted, the DK-crush technique had a lower rate of major adverse cardiovascular events regarding cardiac death, acute myocardial infarction, target vessel revascularization, and stent thrombosis compared to the provisional stenting technique and any other double stenting technique including T-stent, TAP, dedicated bifurcation stents, crush, and culotte.<sup>6</sup>

Among the complex double stenting techniques, the culotte one is a very flexible technique we can use to choose the branch we want to treat first, the main vessel or the side branch. Recently, changes have been made that improve its result by minimizing stent overlap in the main vessel and adding a first kissing balloon (KB) after the first stent implantation (DK-mini-culotte) thus improving stent conformability at bifurcation level and improving the success rate of the final KB.<sup>7</sup> However, we still don't have any evidence on the results of the DK-crush technique.

Despite the results published with the DK-crush technique, it has not become the technique of choice in most centers because it is technically very challenging since 8 very well-defined steps are involved that can't be omitted since the technique needs to be refined in every step of the way. However, the main setback of this technique is that it is very much time-consuming. Also, the material needed is often unusual and without proper optimization, which means that it can jeopardize results in the real-world. Early POT

(proximal optimization technique) is very important here, also KB with non-compliant high-pressure balloons, and final POT. Similarly, the technique needs to be refined based on the recommendations established in the EBC MAIN trial regarding POT, and the KB.

Finally, since this is a time-consuming and challenging technique that takes up a lot of resources, changes to this technique to optimize results and improve procedural times are almost non-stop. One of them is high-pressure stent postdilatation of the side branch at ostial level (proximal SB optimization) that improves stent conformability at carina level and facilitates later recrossing.<sup>8</sup> The other one is the DR-crush (double rewire crush) technique that facilitates sequential dilatation of the side and main branches thus avoiding early KB, which simplifies the entire procedure with very good results at 2 years.<sup>9</sup>

**Q.:** In your opinion, do you think that the use of intravascular imaging modalities to guide these procedures on the left main coronary artery is important?

**A:** I believe we all agree that the use of imaging modalities to treat these bifurcation lesions at the left main coronary artery is mandatory to both plan the strategy that should be followed and assess the final outcomes. It is the only way to offer the best possible results in a lesion of such prognostic impact. Regarding the most appropriate technique, I think it should be the one the operator is more familiar with. Although it is true that intravascular ultrasound has gained traction to treat the left main coronary artery, since distal segment is involved and as long as we're not dealing with short left main coronary arteries or excessively large calibers preventing good contrast, the optical coherence tomography would also be useful thanks to its high spatial resolution.

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## CONFLICTS OF INTEREST

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