8. Bifurcation lesion

c) Cutting balloon

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A. Advantages and Limitations of Cutting Balloon Angioplasty for the Treatment of bifurcation lesions

PCI often produces a sub-optimal result in bifurcation lesions due to problems such as dissection or plaque shift, inflation of only one branch, or ostial stenosis or occlusion of the second other branch. The problem with bifurcation lesions is that the vessel's resistance to a conventional balloon is often high, given the high frequency of calcified plaque in these lesions. Cutting Balloon Angioplasty (CBA), on the other hand, is thought to reduce incidence of dissection because the plaque is incised by the tiny blades mounted on its surface, and to minimize plaque shift, compared to a conventional balloon. Therefore, the use of the Cutting Balloon in bifurcation lesions may keep the negative effects of balloon inflation on the side-branch to a minimum and may permit sufficient lumen gain without elastic recoil. The Cutting Balloon, however, has a large profile and less flexibility because of its blades, and its usage is limited, especially in sharp bifurcations. Another potential pitfall is that the Kissing Balloon Technique (KBT), now the standard of contemporary PCI for bifurcation lesions, is problematic with the Cutting Balloon.

Dilation of bifurcation lesions using KBT may be an effective strategy when the reference diameter at the proximal site of the lesion is large enough for two balloons to overlap at the proximal site, but vessel injury often becomes an issue if the reference diameter is too small. High pressure may be necessary when insufficient inflation is achieved at the bifurcation site, which entails an increased risk of dissection at the proximal site. Also, when bifurcation lesions have severe stenosis in both the main and side- branches, plaque shift can make it difficult to dilate both branches without dilating at the same time using KBT. For these lesions kissing balloon technique may be the most effective primary technique.

B. Basic strategies

For the treatment of bifurcation lesions, it is important that operators have a primary strategy. For lesions that require KBT, having a tried and trusted system to follow from the beginning can save procedure times and contrast medium, and also reduce problems later. On particular pitfall is that repeatedly pushing the balloons back and forth with the two guidewires can easily run into trouble, such as the guidewires getting tangled in the guiding catheter or the balloon getting stuck. We feel that the most beneficial use of CBA for bifurcation lesions is that it may allow you to avoid putting a stent in. The problem with stenting is that treatment options are limited, if the lesion restenoses. Lesions that undergo T-stenting or Y-stenting, with stents implanted in both main and side- branches, can see beautiful acute results, but we try to avoid these complex strategies because of the higher restenosis rate compared to single stenting. So, when selecting a strategy for bifurcation lesions, first of all, consider whether use of the Cutting Balloon or a debulking device is feasible. Then, only implant stents in those lesions contra-indicated for these other devices. If attempting to salvage the side-branch of a lesion consisting of stenosis in both the main and side- branches, (i.e. a "true" bifurcation lesion), try KBT as a primary strategy without using any Cutting Balloons, as this will save balloons: the only dilatation method likely to give you an optimal result is the kissing balloon technique

C. Indications of Cutting Balloon Angioplasty for Bifurcation Lesions

In summary, we consider the indications of Cutting Balloon Angioplasty for bifurcation lesions to be as follows;

1. Stenosis at the bifurcation site in the main branch with no significant stenosis in the side-branch. (No dilatation is needed for the side-branch, so KBT is not required)
2. The difference in proximal and distal reference diameter either side of the bifurcation site is small (KBT may cause severe vessel injury at the proximal site in these lesions).
3. The side-branch is small, and occlusion by balloon dilatation carries no risk.
4. The lesion is focal and not very calcified…i.e. can be expected to respond well to CBA.

The corollary is that when KBT or stenting *are* required, as described above, use a conventional balloon or primary stenting, and avoid CBA.

The following sets out how to select a strategy from bifurcation lesion morphology.

Table 1. Classification of the characteristics of bifurcation lesions

A. Stenosis both at the main branch and the side-branch ostium
B. Stenosis at the main branch but no stenosis in the side-branch
C. Proximal or distal stenosis in the main branch and stenosis at the side-branch ostium
D. Proximal or distal stenosis in the main branch and no stenosis in the side-branch
E. Stenosis in the side branch only

For the treatment of type A bifurcation lesions, stent the main branch and post-dilate using KBT, especially when the side-branch needs to be salvaged.
For type B, KBT is often required, but in some cases the Cutting Balloon may be effective, and it is important to assess lesion morphology when selecting your strategy.
For type C, as a result of using the Cutting Balloon in the main branch, KBT may not always be necessary, and depending on the condition of the side-branch, a conventional balloon may suffice.
For type D, dilate only the main branch with the Cutting Balloon, trying not to touch the side-branch.
The Cutting Balloon may also be effective for type E, if you can get it across the lesion.

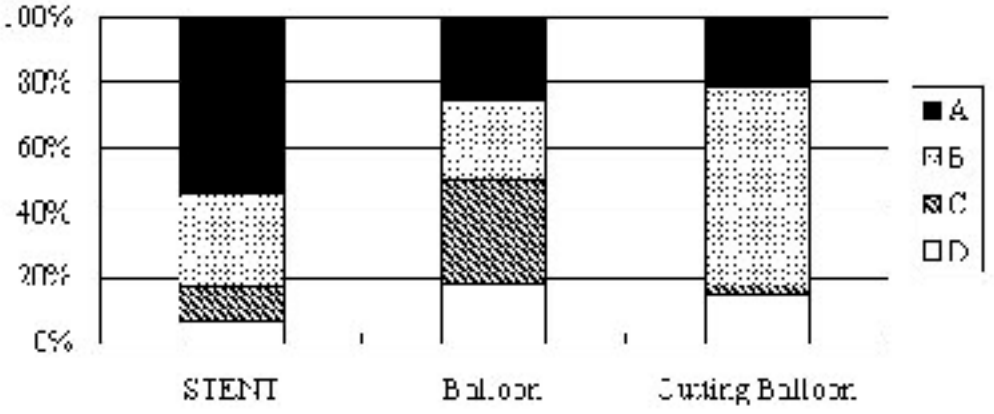
In addition to the above rough classification, when assessing indications, generally let the size of the side-branch, the presence of calcification, lesion length, and the condition of patient be your guide. And always considered using debulking devices such as DCA or Rotablator before balloon dilation, if it is possible.

Table 2 shows a breakdown of the frequency of stent placement and Cutting Balloon use for bifurcation lesions in our hospital. Stents were placed in 64% of cases (94/146) and Cutting Balloon used in 23% (33/146). Looking at the distribution of lesion characteristics, type A lesions were more common in the stented group, with type B a major presence in the CBA Balloon group. Restenosis rates were did not differ significantly in the three groups, but the frequency of KBT use was significantly lower in the CBA group. In other words, CBA is the best strategy for lesions which do not require KBT.

	stented	not stented		p-value
		PTCA	CBA	
No. of lesions	94	19	33	
Kissing Balloon	28(30%)	7(37%)	1(3%)	0.025
Angiographic Restenosis	25%	31%	33%	0.41

PTCA; conventional angioplasty. CBA; cutting balloon angioplasty

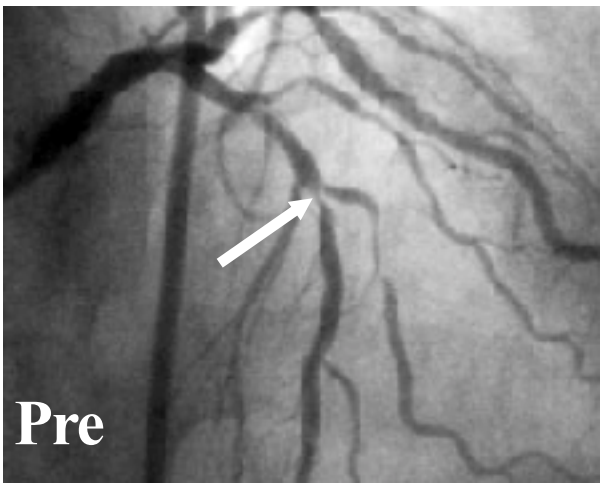
Table 2. Breakdown of treatment strategy by bifurcation lesion-type

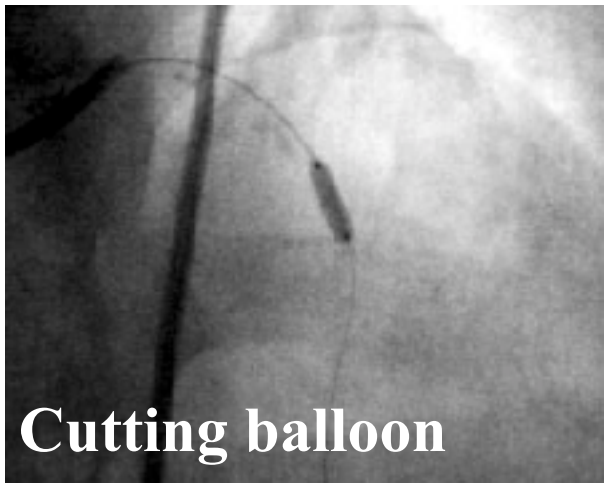


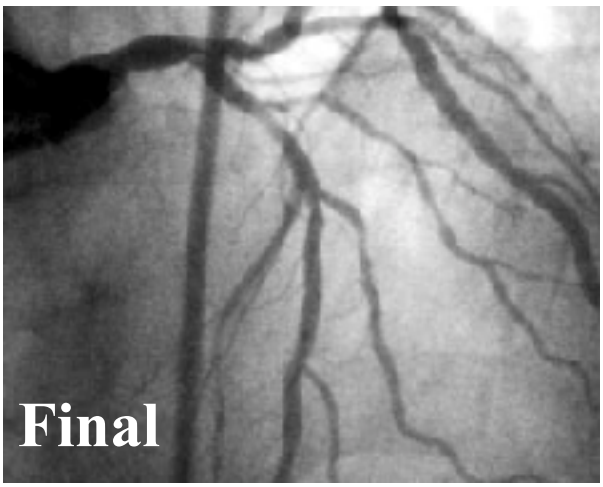
D. Case Reports

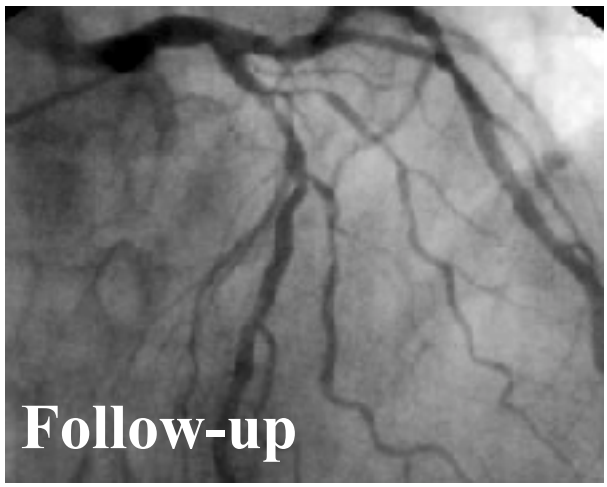
Case 1

A bifurcation lesion in the LAD and diagonal branch, with main trunk stenosis distal to the bifurcation. CBA was performed on the main branch. The lesion was type D, but there was also stenosis distal to the diagonal branch, and the lesion was dilated with a conventional balloon. No restenosis was observed at 6-month follow-up.

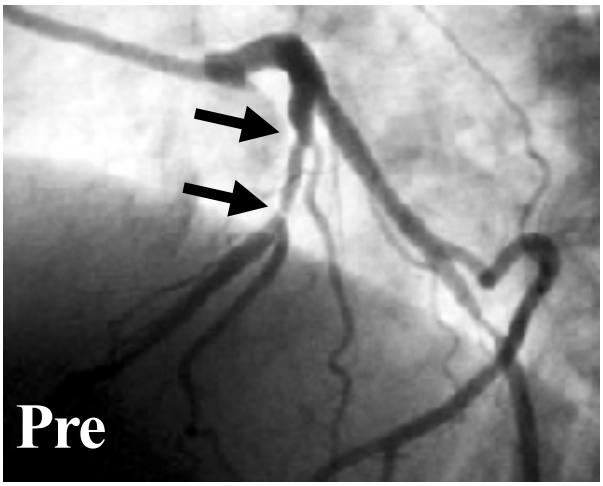


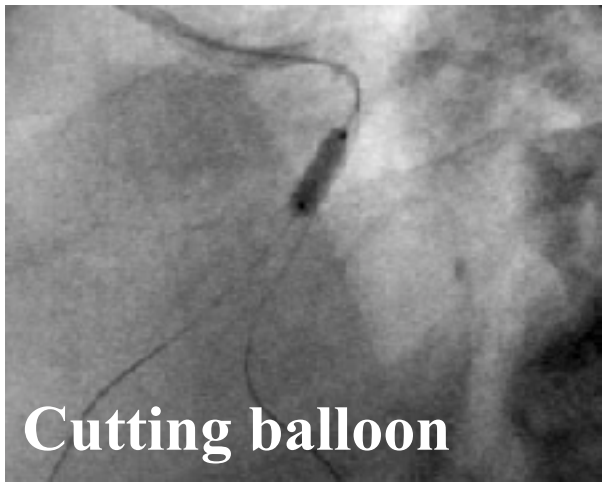


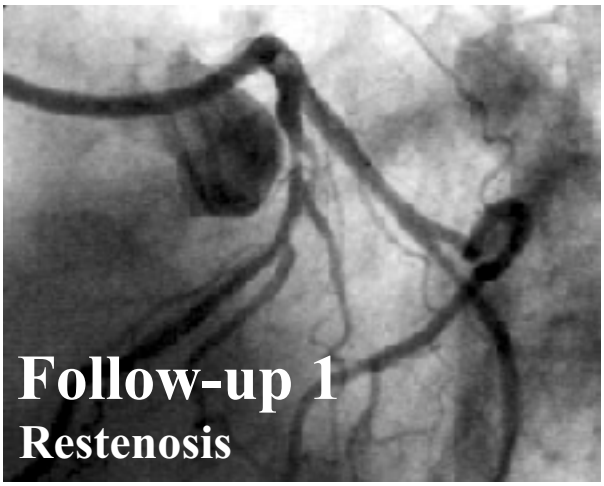


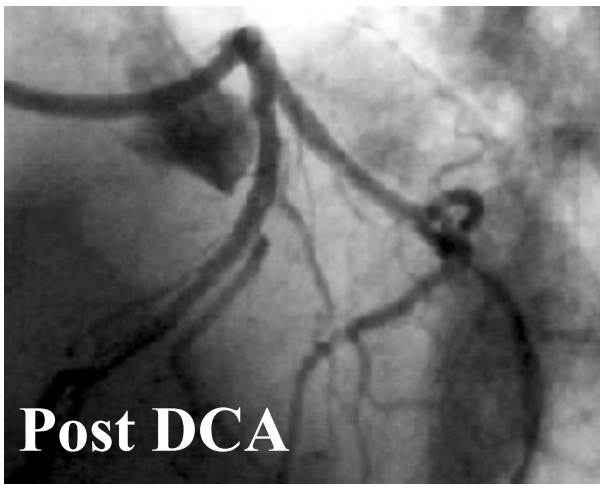


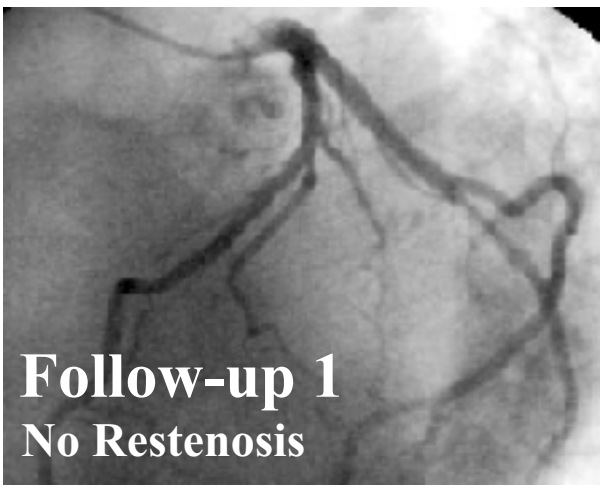
Case 2
A bifurcation lesion in the LAD and diagonal branch. Type D lesion, with only stenosis in the proximal main branch. and finished The procedure ended after dilation with a Cutting Balloon but the lesion restenosed. DCA performed and no re-restenosis observed.



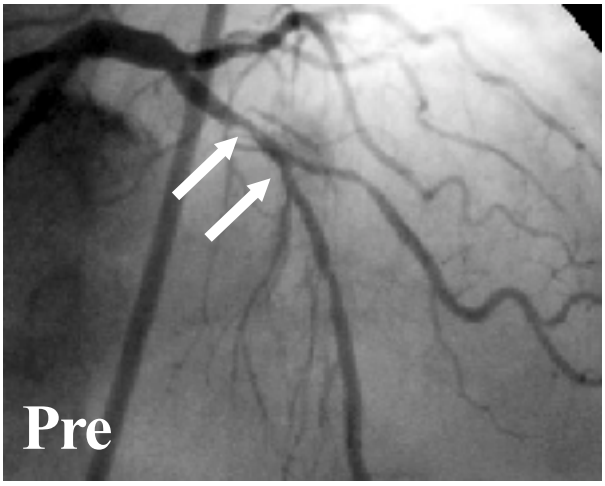


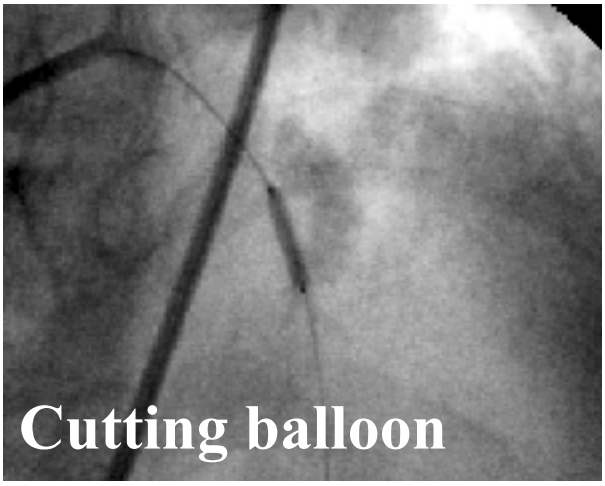


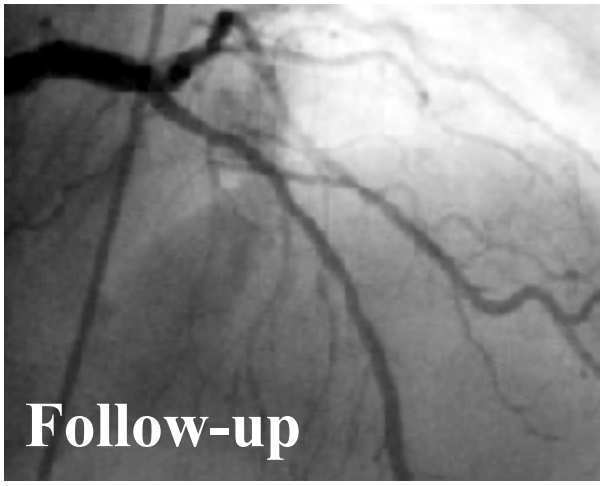




Case 3
A bifurcation lesion at the LAD and diagonal. Stenosis was diffuse in the LAD proximal to the bifurcation site. We tried not to treat the diagonal branch as stenosis there was also diffuse. Cutting Balloon was performed only at the main branch, with no restenosis at 7-month follow-up.







Case 4
A restenotic lesion bifurcated at the diagonal branch. A multi-link stent was implanted, "jailing" the side-branch. The main branch was dilated with a Cutting Balloon and the side-branch with a conventional balloon. Plaque shift prevented optimal dilatation of both branches, however we tried. The lesion was finally sufficiently dilated using KBT, but the side-branch restenosed at long-term. In in-stent restenosis (ISR) lesions, plaque shift is common due to the soft neo-intima, and this can have a serious impact on the side-branch. So, for this type of case, the Cutting Balloon has limited efficacy and your first resort should be KBT.