TCTAP Fellowship Course
"Left Main & Bifurcation: From Accurate Diagnosis to Treatment"

Lessons of Bifurcation Stenting from the Bench Test

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Disclosure

• There is no conflict of interest.
Why is bench testing necessary for the bifurcation intervention?

• Stent distortion
• Scaffolding, gap formation

Colombo A, Moussa I, “Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions”
Comparison in resolution for bifurcation analysis

**Absence of strut?**

**IVUS does not have a good enough resolution to analyze SB ostium accurately compared with MFCT images.**

Crush stenting with Bx Velocity

(1) LAD stent over LCX stent

Gap between the two stents

Circle

Murasato Y. Catheter Cardiovasc Interv, 70, 211, 2007
Kissing stenting

Cross sectional view

proximal

Compressed LCX stent

distal

Murasato Y. Catheter Cardiovasc Interv, 70, 211, 2007
Modified T-stenting

Slice at lower horizontal level

Gap

Metallic carina

Murasato Y. Catheter Cardiovasc Interv, 70, 211, 2007
Culotte stenting

Murasato Y, Colombo A, Moussa I, Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions

A

B

C

Cypher

Endeavor

Liberte
Flow retardation in carina after Culotte stenting

Murasato Y, Iwasaki K et al. J Interv Cardiol, 2010
Side branch stenting from main vessel (1)

Right bifurcation angle

Dumbbell shape

Maximal inflation pressure

GW position was not changed during inflation.

Murasato Y, 3rd European Bifurcation Club, 2007
Deviated position of the GW during balloon dilation in the right-angled bifurcation
Distortion of Bx Velocity stent deployed at extreme angle

Murasato Y, 3rd European Bifurcation Club, 2007
Potential problem with stenting from LMCA to LCX

Murasato Y, Colombo A, Moussa I, Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions

**Straight vessel**

a. Initial phase of inflation

b. Maximal inflation pressure

**LMCA bifurcation**

a. Hinge motion may cause fracturing in the structure of the stretched struts of the LCX stent at the ostium.

GW position:
- proximal: outside
- middle: inside
- distal: outside

Balloon: Dumbbell shape

GW position: no change

Balloon dilatation:
- less uniform
- proximal: overdilatation
- middle: restricted
- distal: overdilatation

Gap: side branch ostium

Stretched strut
Strut deformation induced by partial over-sized dilation

Why was the strut over-dilated in the distal edge of the balloon?
- 2-link stent cannot tolerate the initial extreme dilation of the distal edge of the balloon (dog-bone phenomenon).
- 2-link stent: not ideal for POT?

Basalus MW. EuroIntervention. 2010; 6:141-8
The relationship between the place of GW cross and stent deformation after KBT

Murasato Y, Colombo A, Moussa I
“Tips and Tricks in Interventional Therapy of Coronary Bifurcation Lesions

Distal strut
Mid strut
Proximal strut

Scaffolding at the SB ostium

Protrusion of the distal strut into the MV
GW recross position

Central cell  Distal cell
Excessive distal positioning of the GW has a potential risk of stent deformation.
More serious stent deformation in 2-link stent with the GW crossed through the extremely distal cell

Central cell

Distal cell

Driver stent
Ineffectiveness of FKB on the MACE in 1-stent strategy

**COBIS**

Korean Coronary Bifurcation Stenting Registry

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<th>No FKB (%)</th>
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**Nordic – Baltic III**

Niemela M, Circulation 2010

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<tr>
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Various configurations of the proximal MV stent which are dependent on the operator’s decision.
Two overlapping styles in KBT

Minimal overlapping + Proximal large ballooning

- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
  - MV Ryujin 3.5/20
  - SB Ryujin 3.0/20
- prox MV
  - Quntum Maverick II 4.5/8, 12atm

Long overlapping

- ML Vision 3.5/28, 14atm
- SB Ryujin 3.0/20, 12atm
- KBT (6atm)
  - MV Ryujin 3.5/20
  - SB Ryujin 3.0/20

Mitsudo’s law

\[ 3.5^2 + 3.0^2 = 4.6^2 \]

Murasato Y, EBC 2009
Minimal overlapping + Proximal large ballooning

Long overlapping
Minimal overlapping + Proximal large ballooning

Long overlapping
Diastolic peak flow

(a) Circle φ4mm

(b) Circle φ5.5mm

(c) Ellipse-longitude

(d) Ellipse-tilt

0 2.5 5 Pa
Which is more suitable, 2-link or 3-link?

Cross sectional view

Balloon overlapping changed from lateral to longitudinal position.

Wide opening for the SB

3D, Y-shape model

Endeavor 3.0/24
KBI (3.5+3.0/20, 8atm)

Murasato Y, Euro PCR 2010
Which is suitable, 2-link or 3-link?

Murasato Y, Euro PCR 2010

Cross sectional view

Stent structure was maintained in the KBI site.

ML Zeta 3.5/28
KBI (3.5+3.0/20, 8atm)

3D, Y-shape model

Balloon overlapping changed from lateral to longitudinal position.
Which is suitable, 2-link or 3-link?

Murasato Y, Euro PCR 2010

When the vertical link was in the SB ostium, the jailed strut remained at the site where the SB balloon crossed over the MV balloon.

SB orifice

ML Zeta 3.5/28
KBT (3.5+3.0/20, 8atm)
Longitudinal stent deformation

Ormiston JA, JACC Interv. 2011, 4, 1310
Compression test

Weakness:
1. Element
2. Driver
3. Liberte, Integrity
4. ML8, Vision
5. Cypher

Ormiston JA, JACC Interv. 2011, 4, 1310
### Stretch test

#### Weakness:
1. Element, Driver
2. Liberte, Integrity
3. ML8, Vision
4. Cypher

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Ormiston JA, JACC Interv. 2011, 4, 1310
Deformation of stent and polymer damage after KB inflation

Guérin P. Circ Cardiovasc Interv, 2010, 3, 120
Polymer lesion after KBI

Guérin P. Circ Cardiovasc Interv, 2010, 3, 120

The improvement in expansion and access abilities may result in the increase in polymer damage as reversed results.
Summary

• Bench testing using high-resolution imaging devices can provide useful information in the complicated bifurcation intervention.

• Any 2-stent technique has the limitation to cover the carinal area.

• Bifurcation angle and balloon overlapping style have great effect on the stent configuration produced by kissing inflation.

• Distal position of the SB GW recrossing is preferable, however, excessive distal positioning of the SB GW has a potential risk of stent deformation.

• Longitudinal deformation is likely to occur in 2-link stents.

• Overdilation of the DES may reduce its efficacy due to the polymer damage, widely spread cell area, and dispersed drug concentration. It also leads to generation of low shear stress which may produce future atherosclerosis or stent thrombosis.