

# Bench Insights into Bifurcation Stenting in the DES Era: An Update



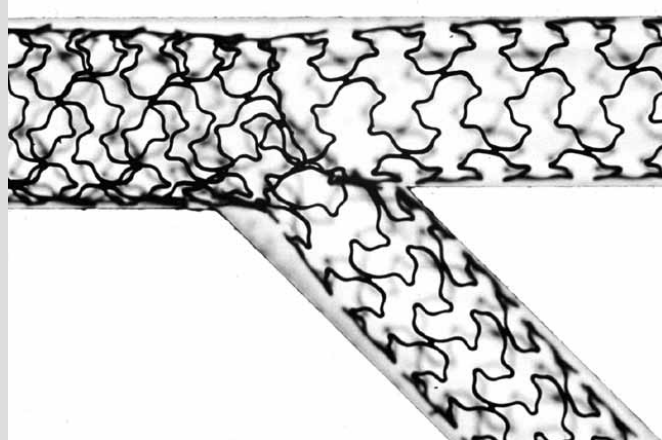
John Ormiston, Mark Webster, Peter Ruygrok, Jim Stewart, Douglas  
Scott, Duncan McNabb, Erin Currie, Monique Panther

Mercy Hospital and Green Lane Cardiovascular Unit at Auckland City  
Hospital, Auckland, New Zealand

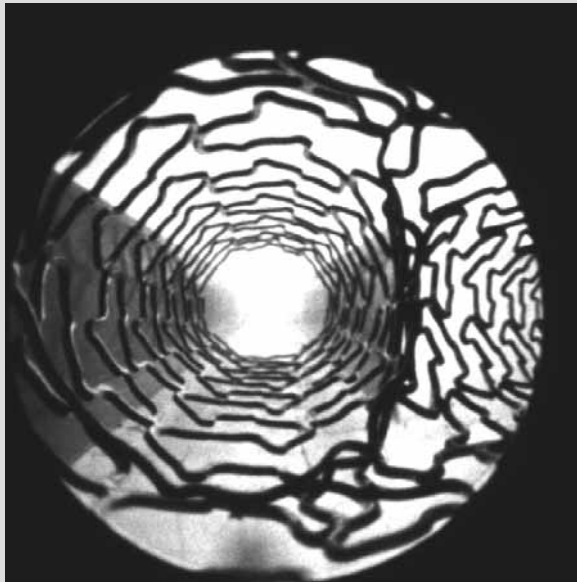
Seoul, 2005

**Some lessons learned from the  
bench**

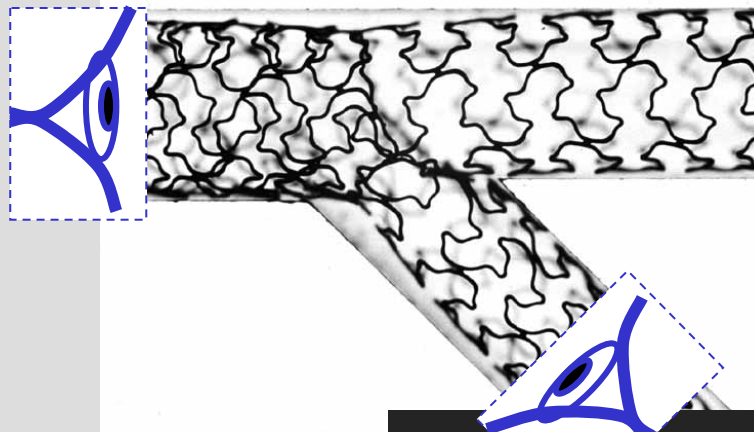
**Methods:** Stents were deployed in a phantom and photographed



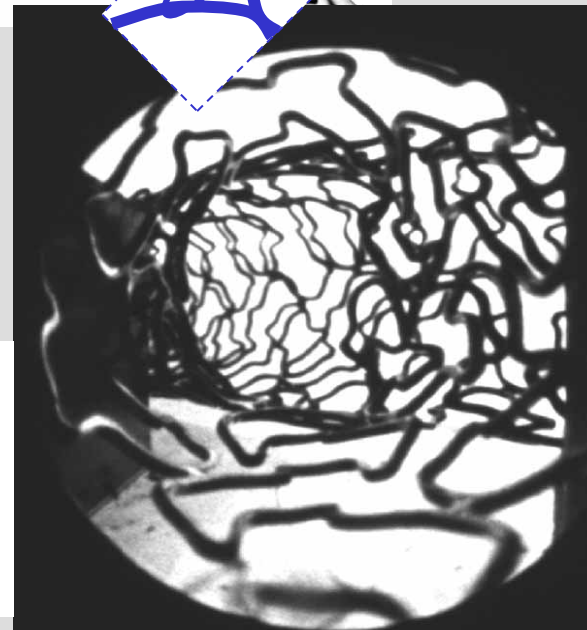
□ Interiors were photographed through a paediatric endoscope



Looking down the main branch



Looking up the side-branch

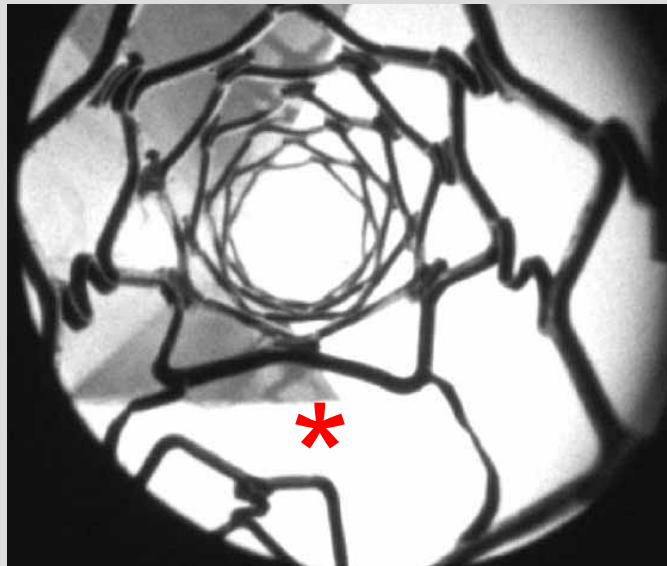
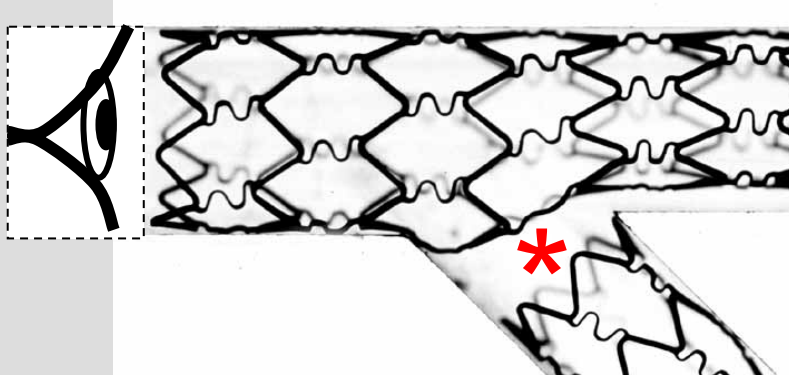


*Ormiston 05*

# Provisional “T” Stenting

*Ormiston 05*

**With provisional “T” stenting, the side-br stent should not be too distal leaving gaps**



The “Randomized Trial to Evaluate Sirolimus-eluting Stents in Coronary Bifurcations” -----

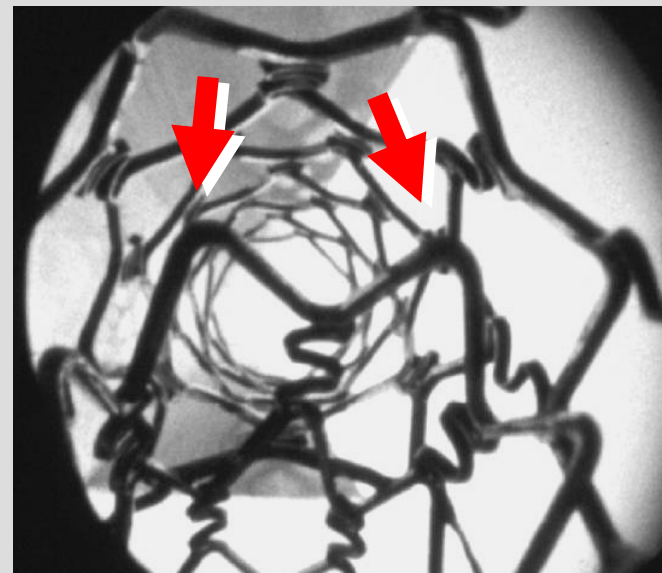
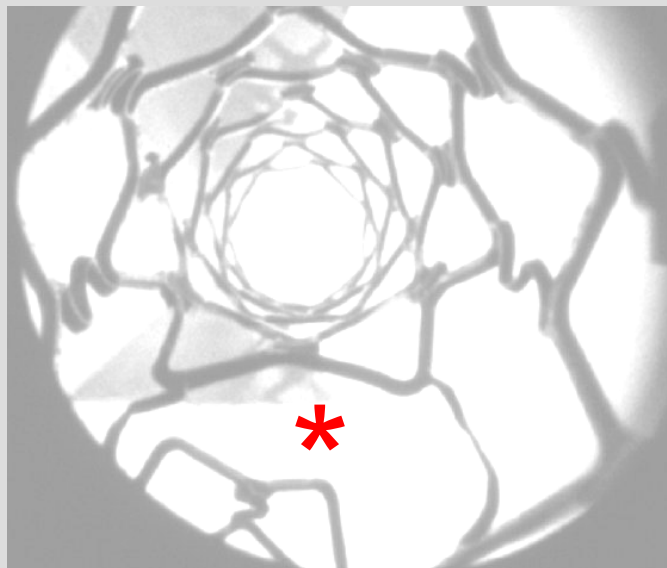
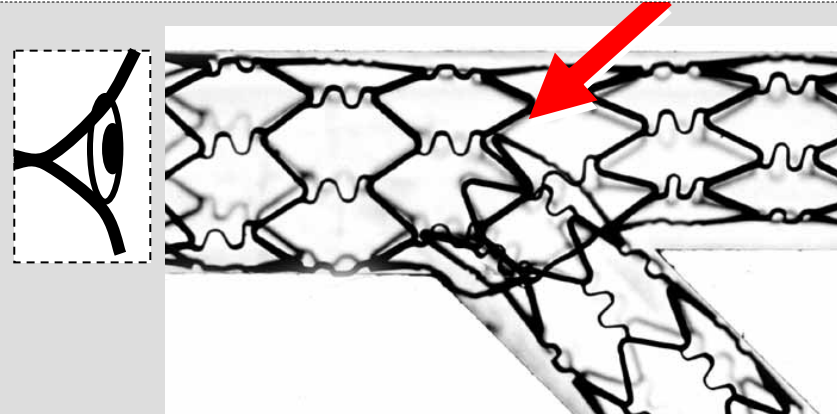
Showed marked reduction in restenosis with SES vs BMS historical controls

Restenoses were at the side-br ostium ?gaps after “T”

(Colombo, Circulation March 04)

*Ormiston 05*

With provisional "T" stenting, the side-br stent should not be too proximal potentially obstructing main br



*Ormiston 05*

# The “Crush” Technique

- ❑ Aimed to reduce restenosis by fully covering the side-branch ostium without gaps in scaffolding or drug application
- ❑ Safe, quick, limited ischemic time
- ❑ Reliably treats the side-branch
- ❑ Always under control
- ❑ “Kissing” balloon post-dilatation is the most difficult and perhaps the most important part



# “Crush” Technique with Zomaxx

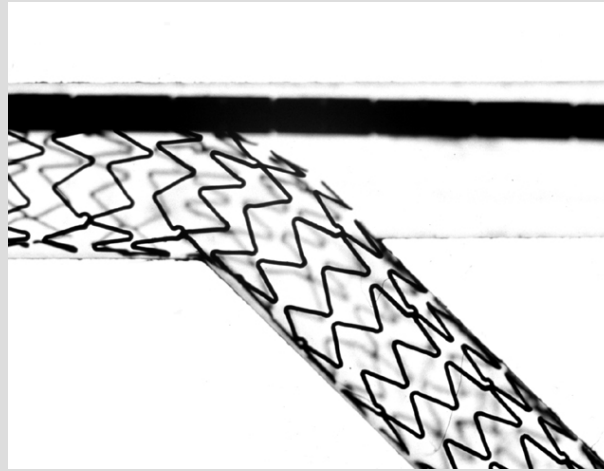


Main br

Side br

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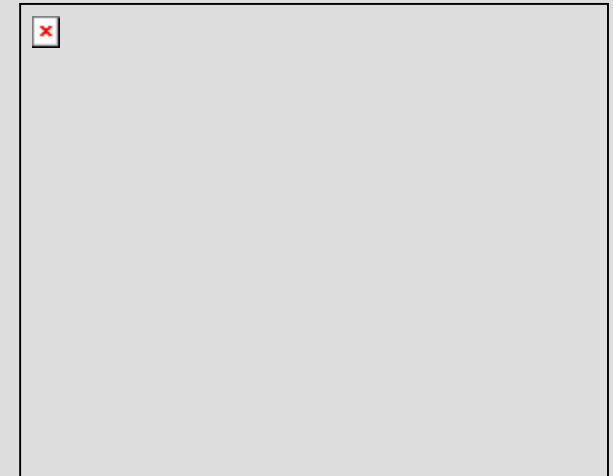
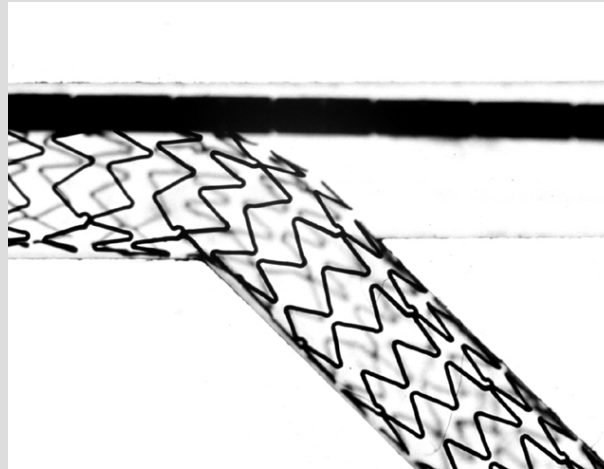
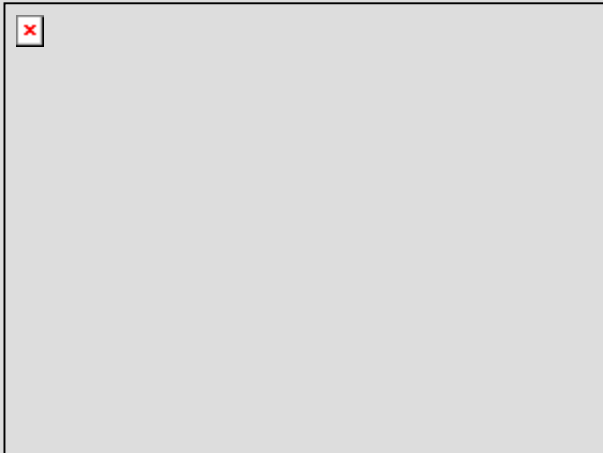
## “Crush” Technique with Zomaxx Stent



Deploy  
side-br  
stent

*Ormiston 05*

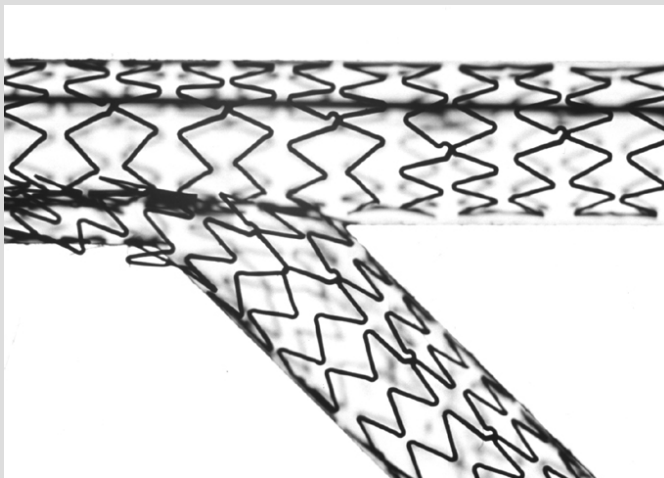
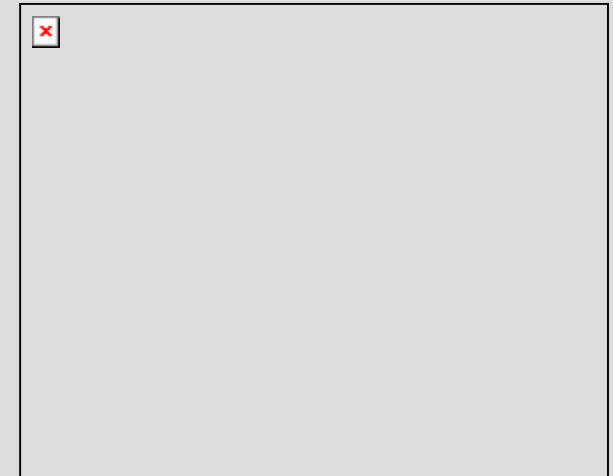
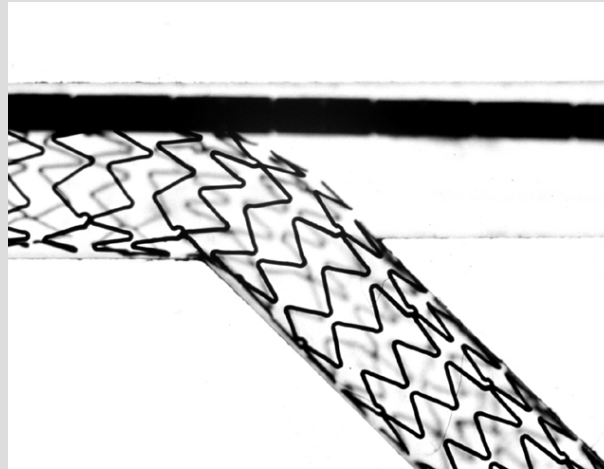
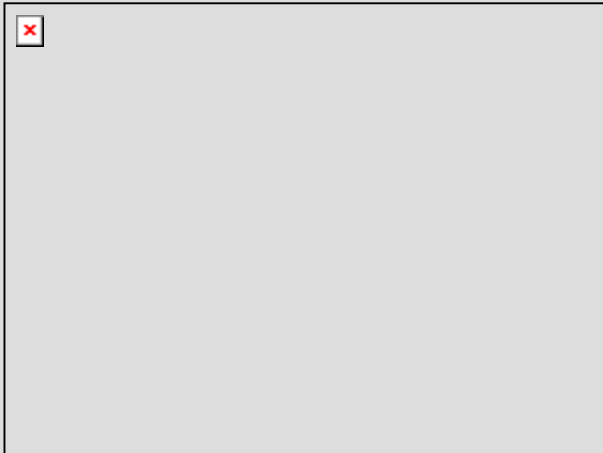
## “Crush” Technique with Zomaxx



Deploy main br  
stent crushing  
side-br stent in  
main br

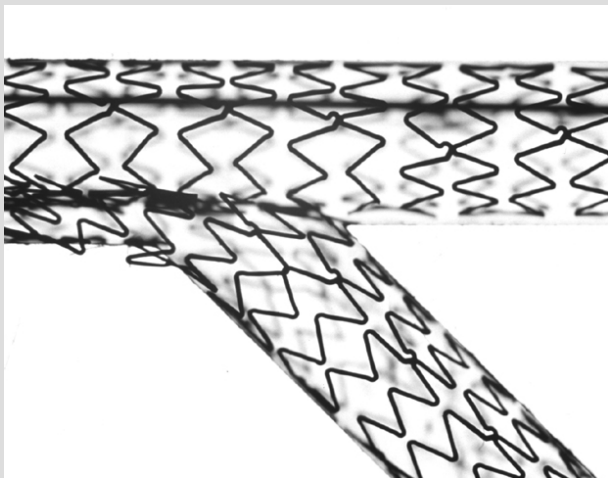
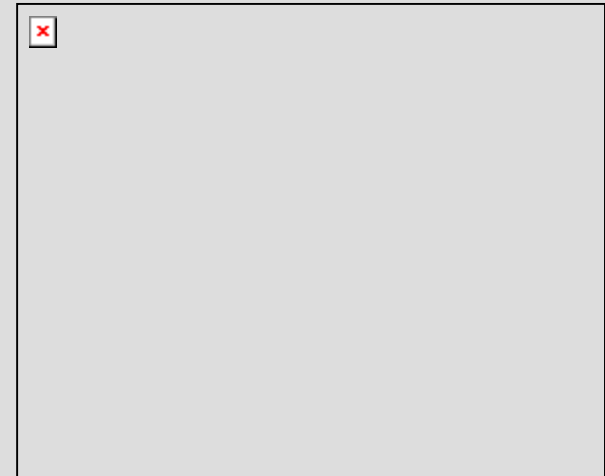
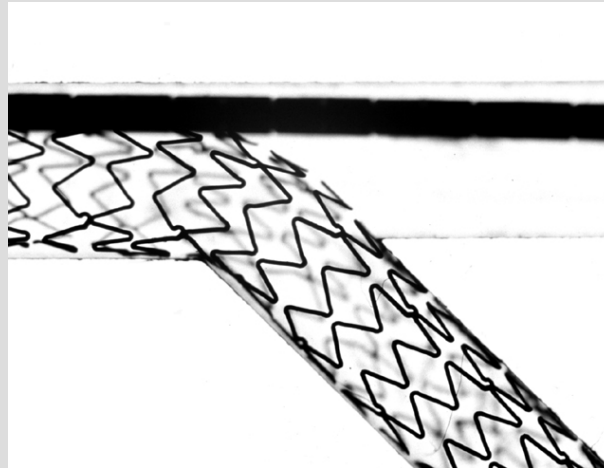
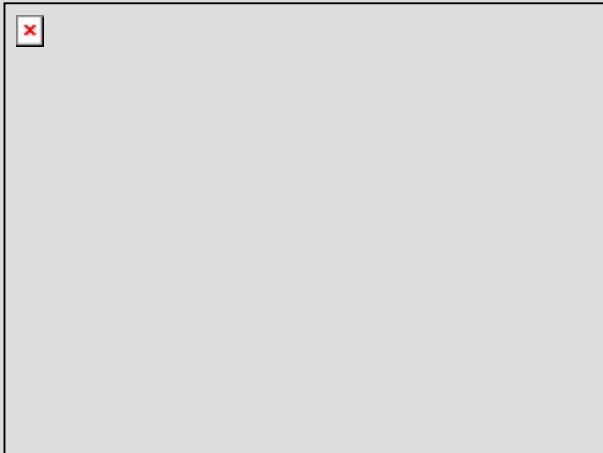
*Ormiston 05*

# “Crush” Technique with Zomaxx



*Ormiston 05*

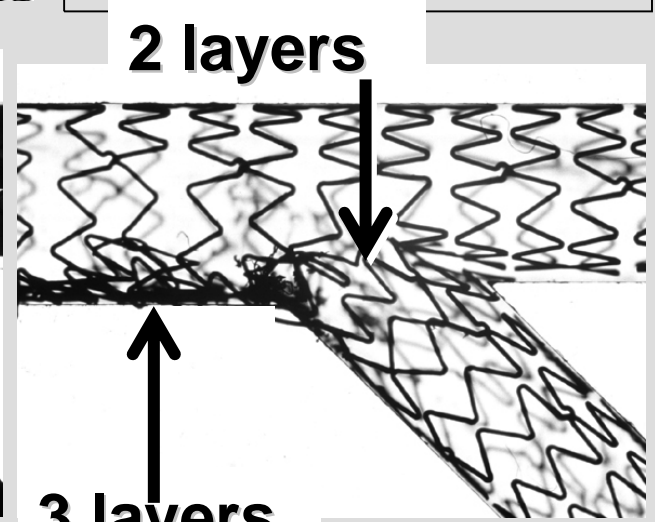
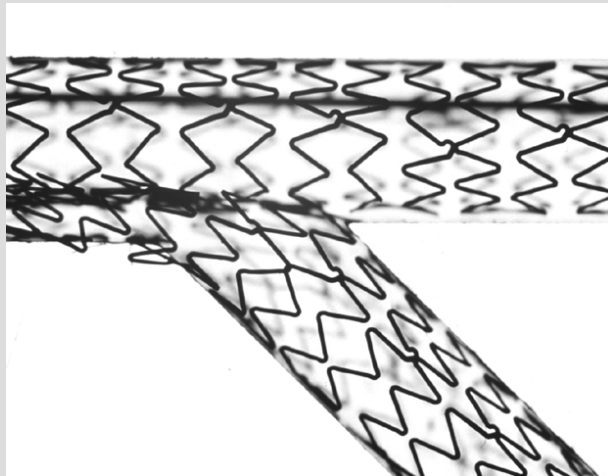
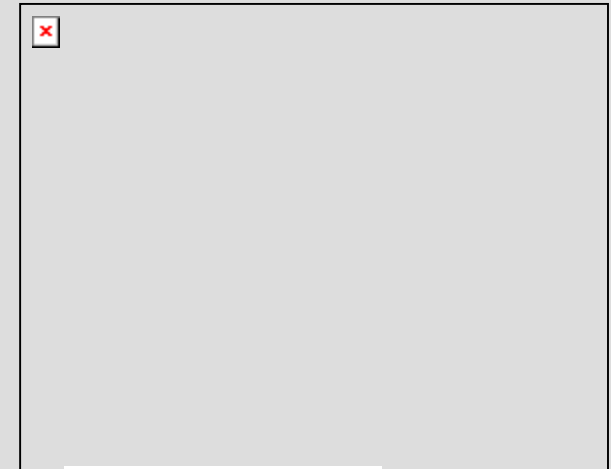
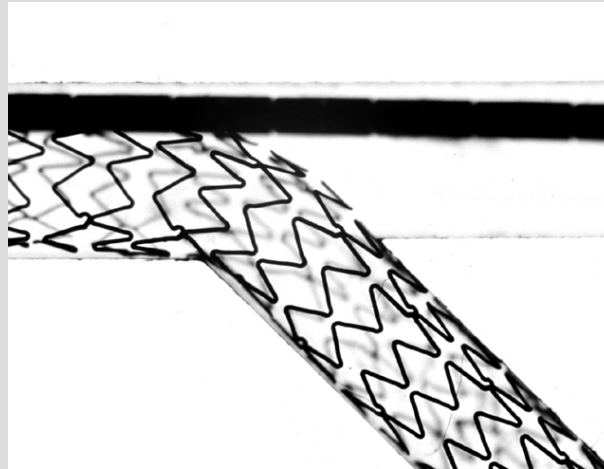
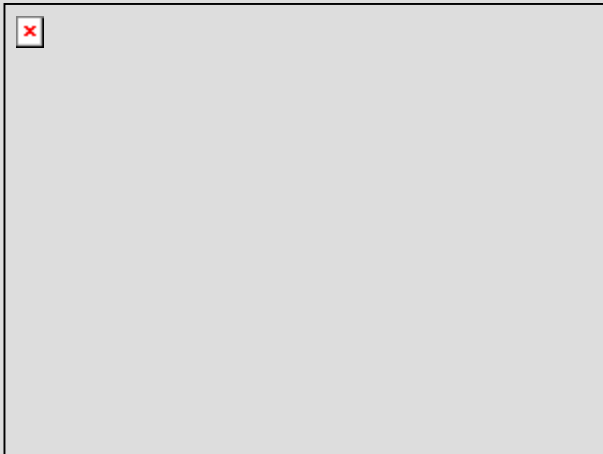
## “Crush” Technique with Zomaxx



“Kissing” balloon  
post-dilatation

*Ormiston 05*

# “Crush” Technique with Zomaxx

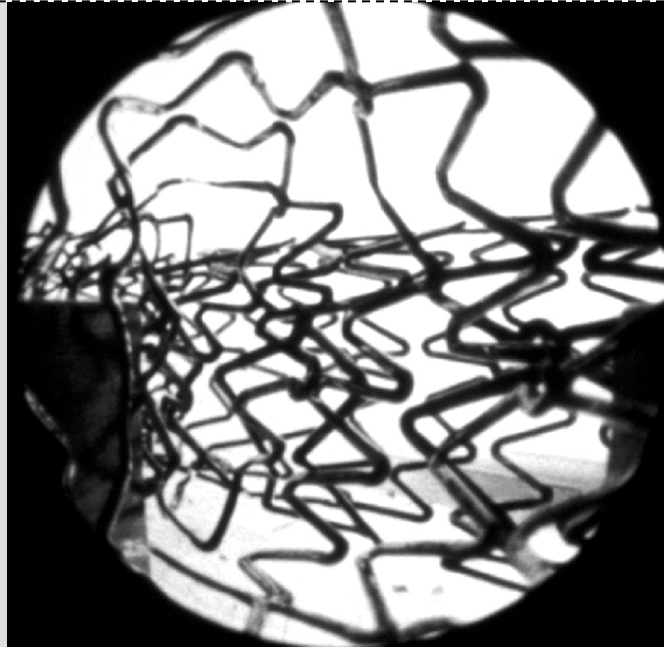
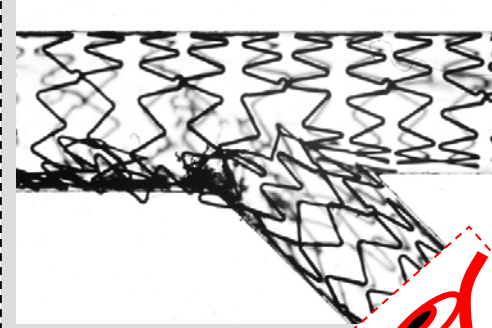


“Kissing” balloon  
post-dilatation

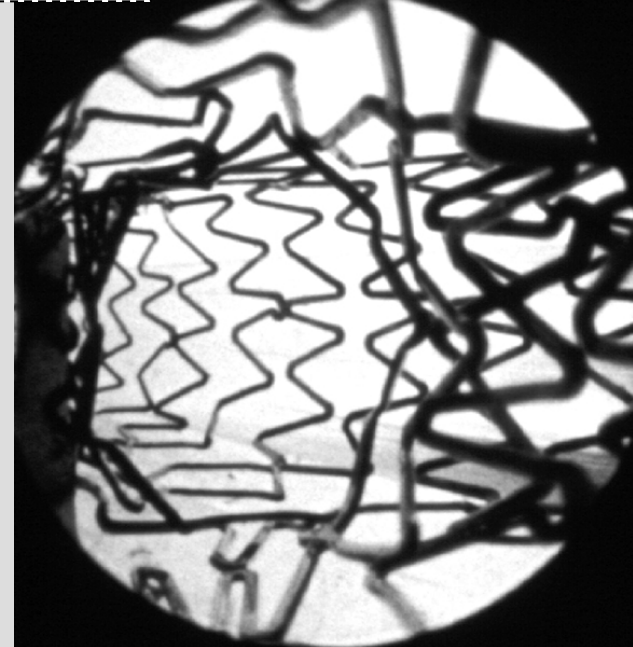
*Ormiston 05*

**After Crush, “kissing”  
balloon post-dilatation  
releases the side-br from  
“jail”**

- Improves subsequent access
- May reduce thrombosis risk

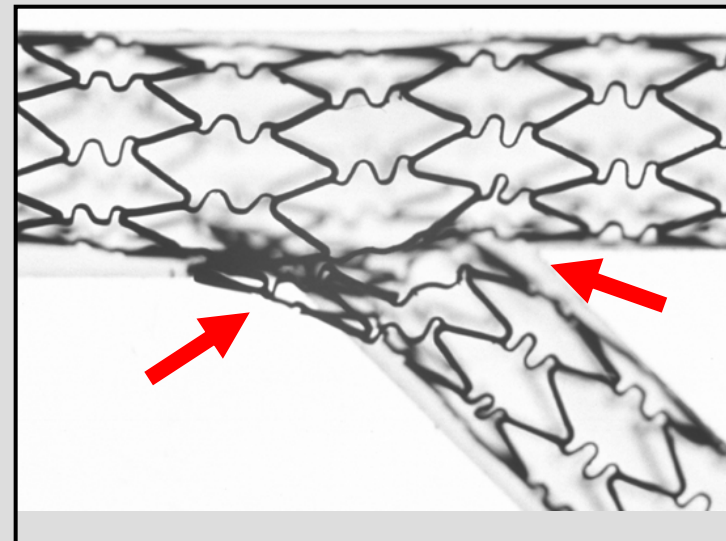
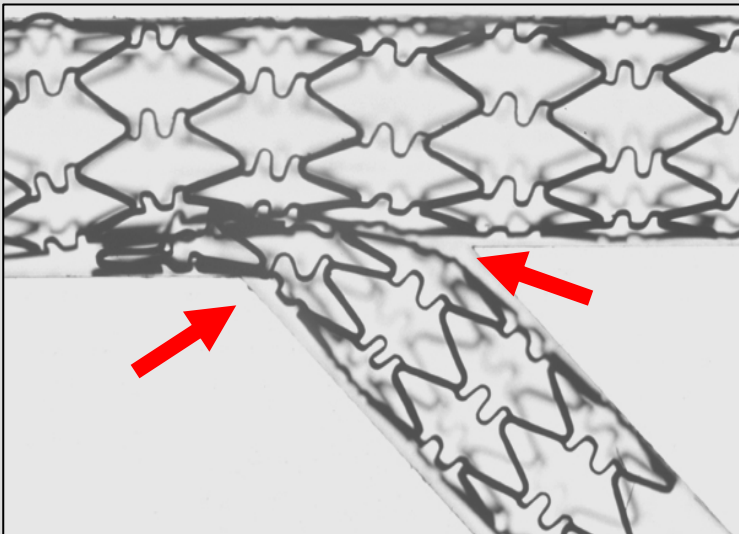


**Before “kiss”  
Side-br jail**



**After “kiss”  
No Side br jail**

Kissing balloon post-dilatation fully expands the side branch ostium improving scaffolding and drug application (Cypher stents)



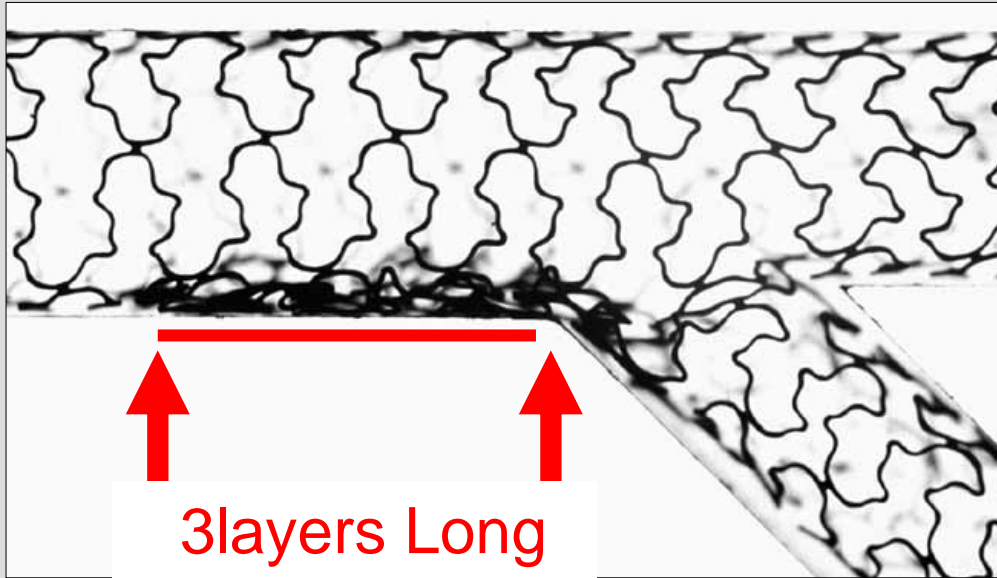
*Ormiston*



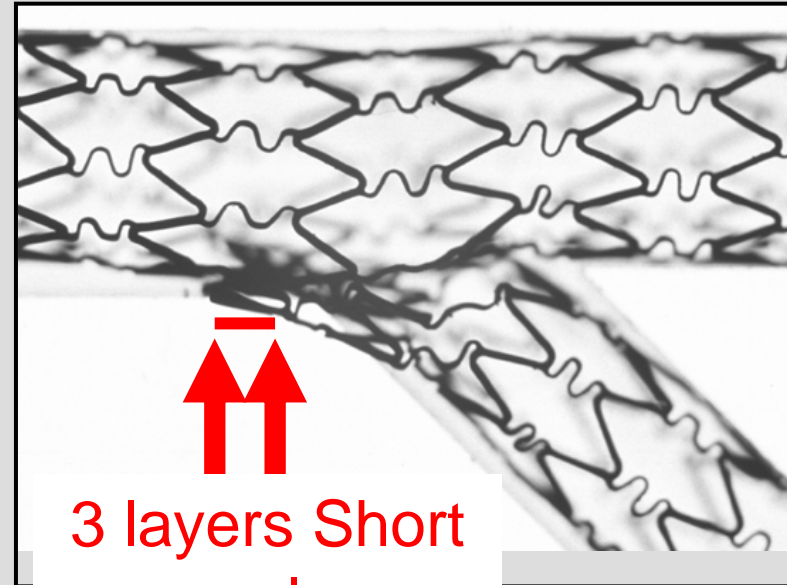
**“If you get a crush you  
should kiss and if you kiss,  
you should do it well”**

**Antonio Colombo,  
Editorial CCVI, 2004**

**It may be wise to limit the length of the 3 layers of overlap**



3 layers Long  
overlap



3 layers Short  
overlap

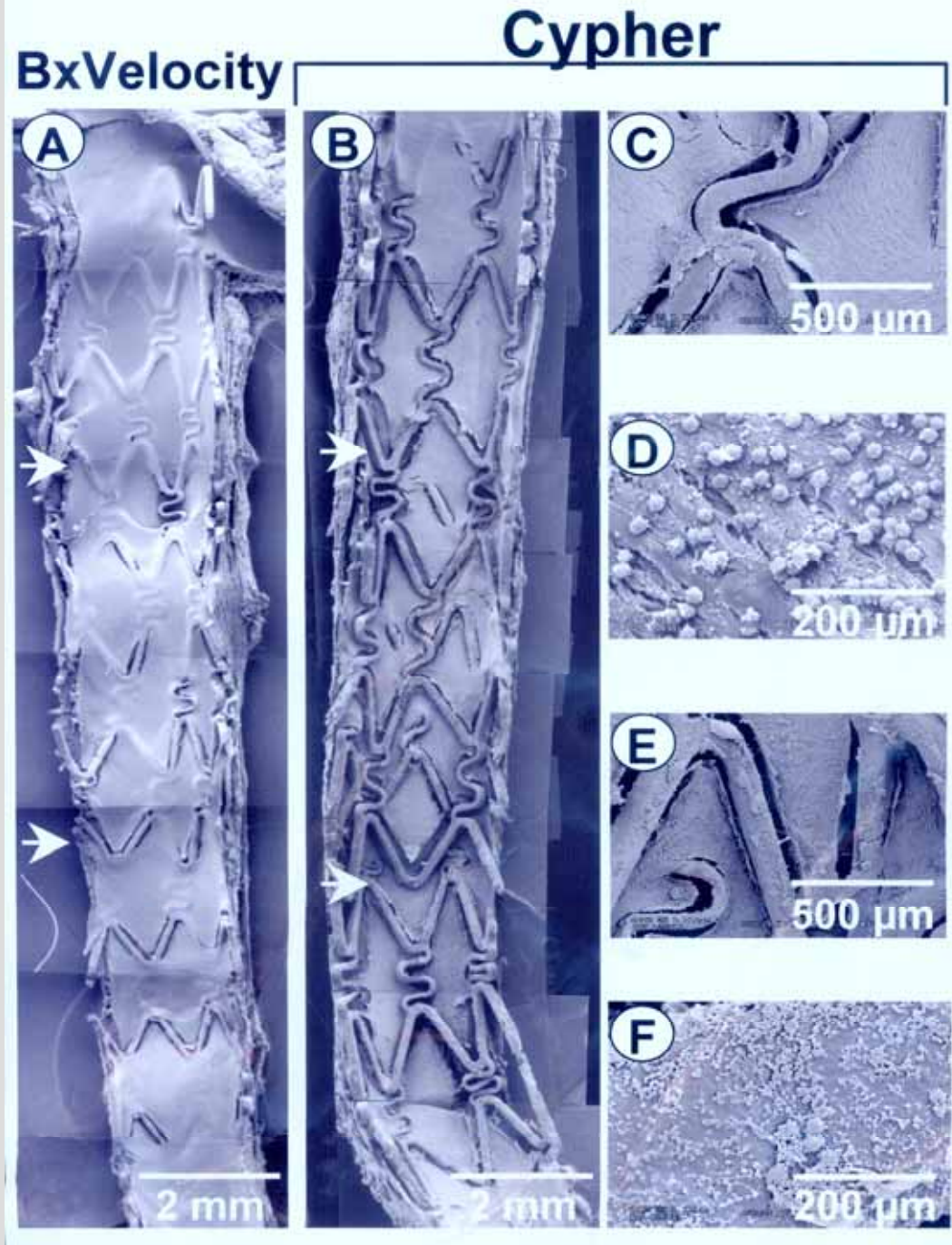
*Ormiston 05*

**Study in NZ rabbits comparing endothelialization after overlapping of bare metal Bx Velocity stents**

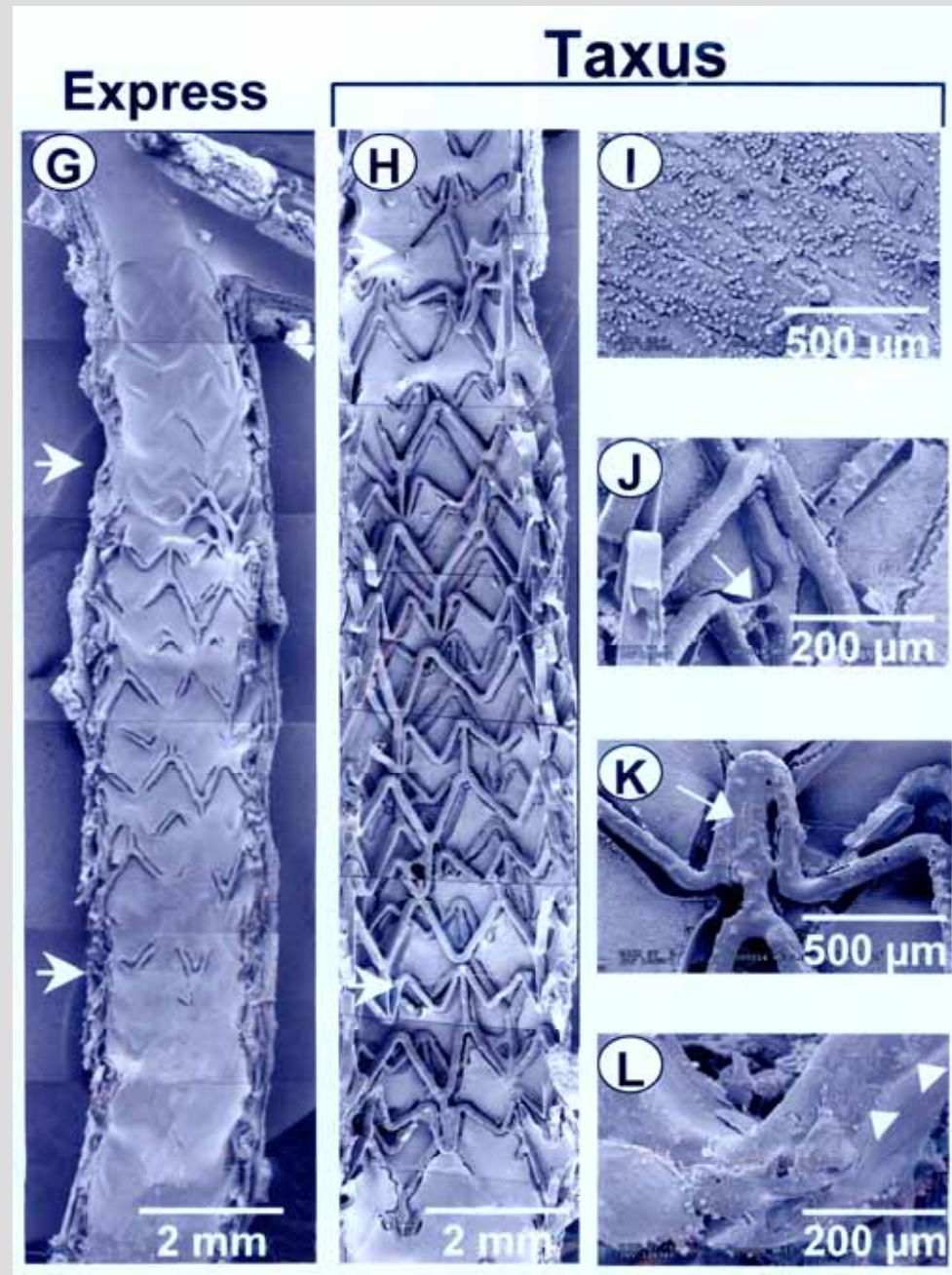
**with**

**Overlapping Cypher sirolimus-eluting stents**

**(Finn, ACC 05)**



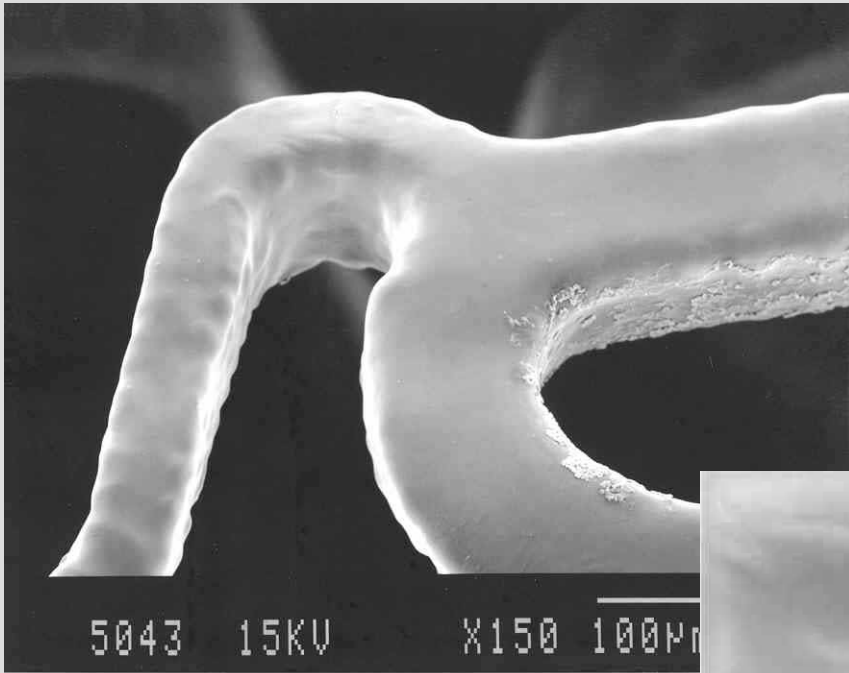
**Study in NZ rabbits comparing endothelialization after overlapping of bare metal Express stents with Overlapping Taxus express stents In rabbits (Finn, ACC 05)**



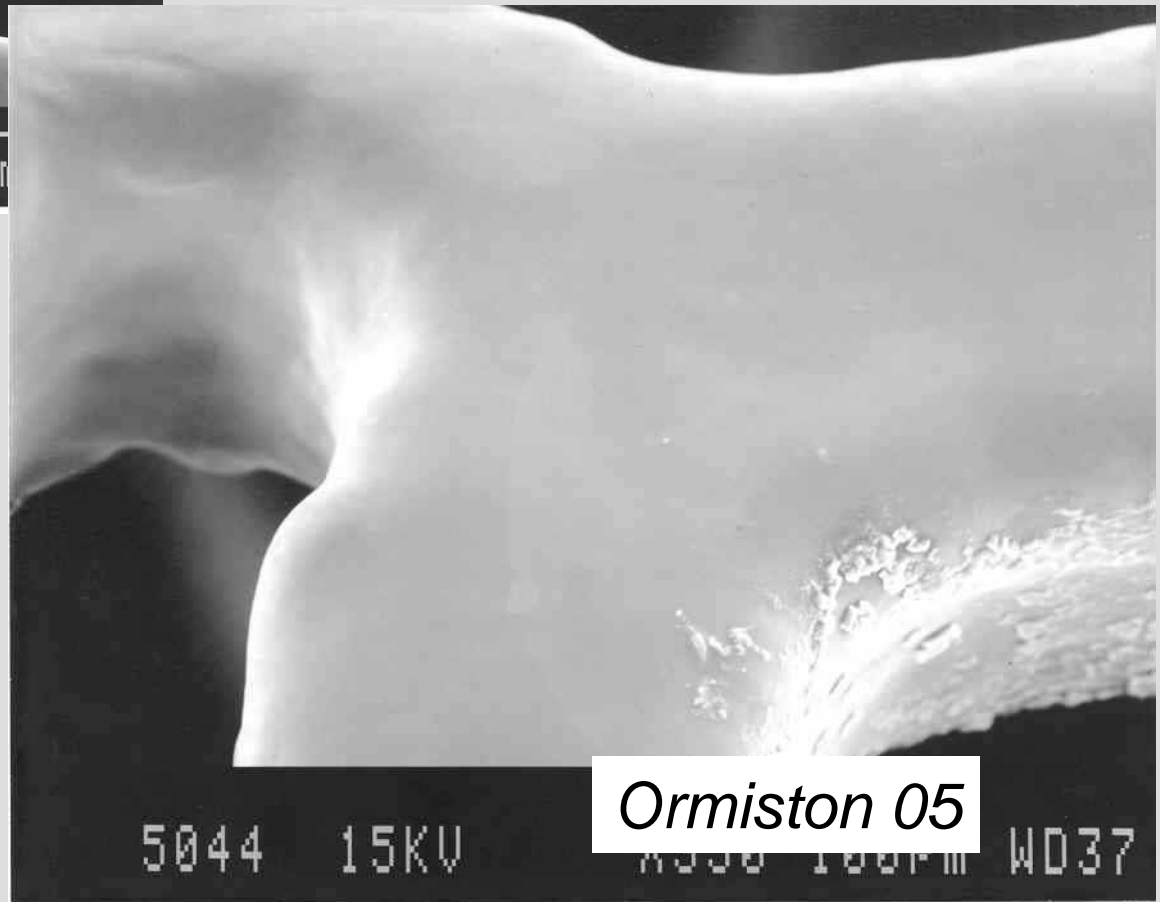


- Endothelialization with BMS was better than with DES
- Endothelialization with a single layer of DES was better than with overlap

# Scanning Electron Microscopy of DES polymers

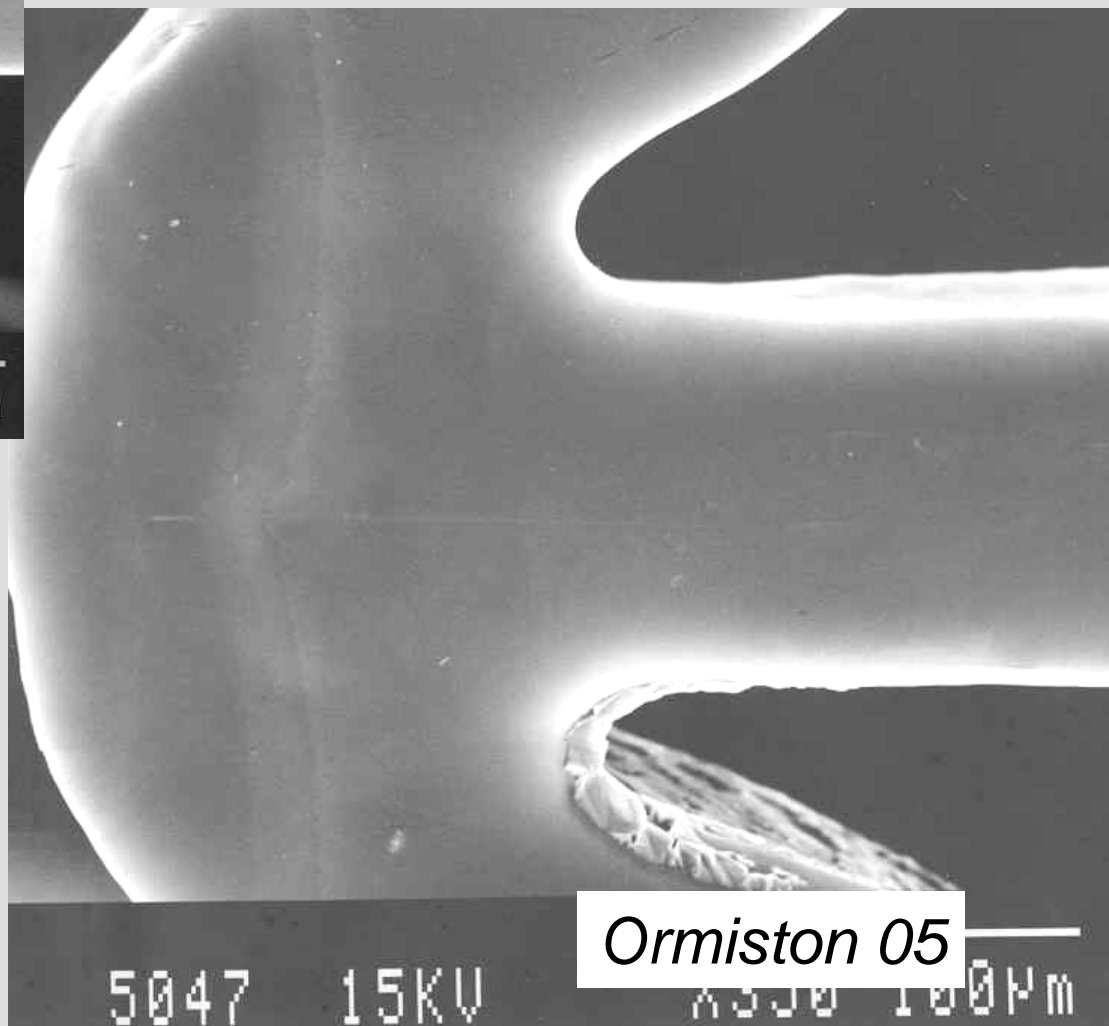
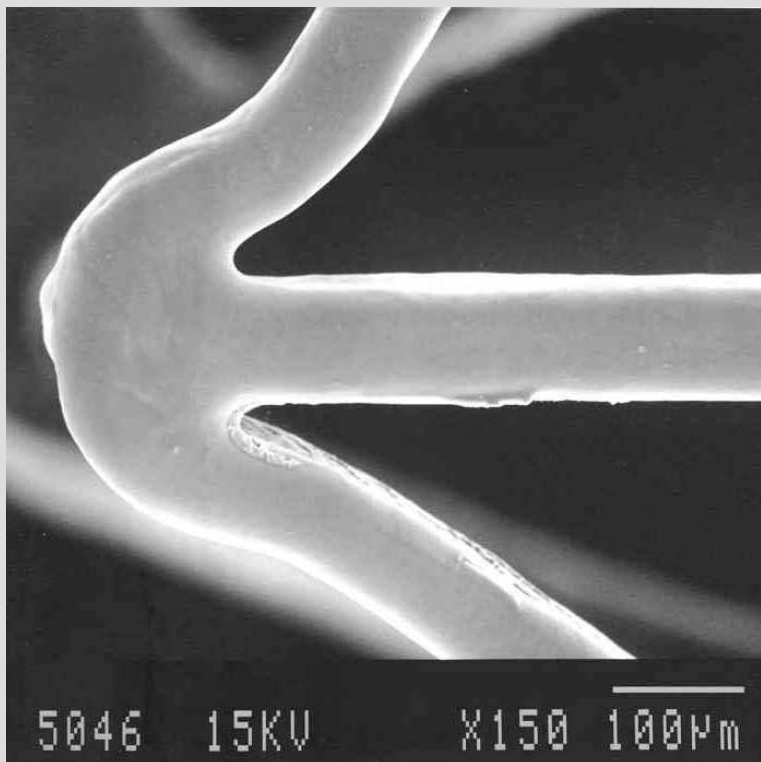


Expanded Cypher stent  
normal polymer  
appearance



*Ormiston 05*

**Normal** appearance of  
the polymer on the  
expanded Taxus stent

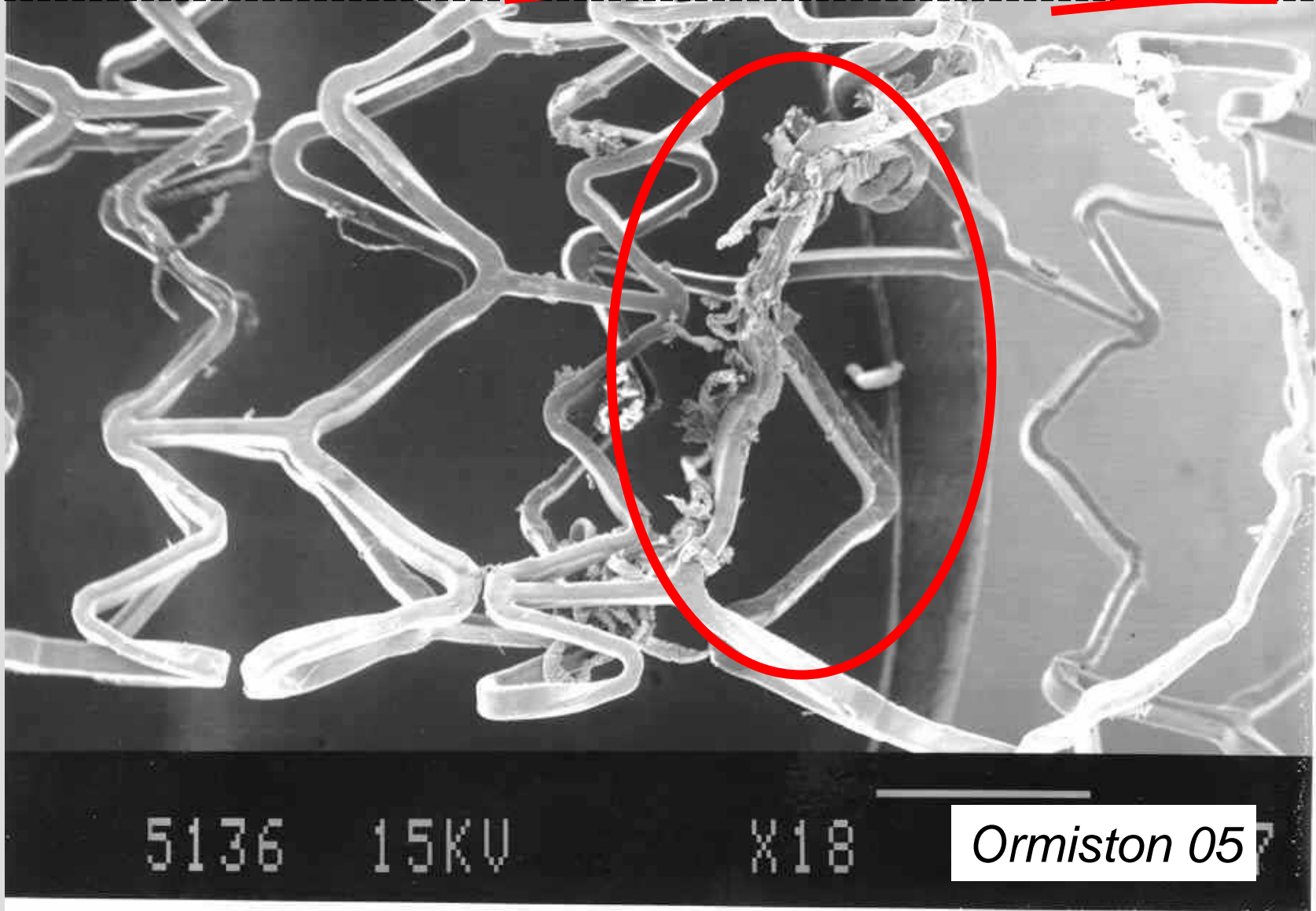


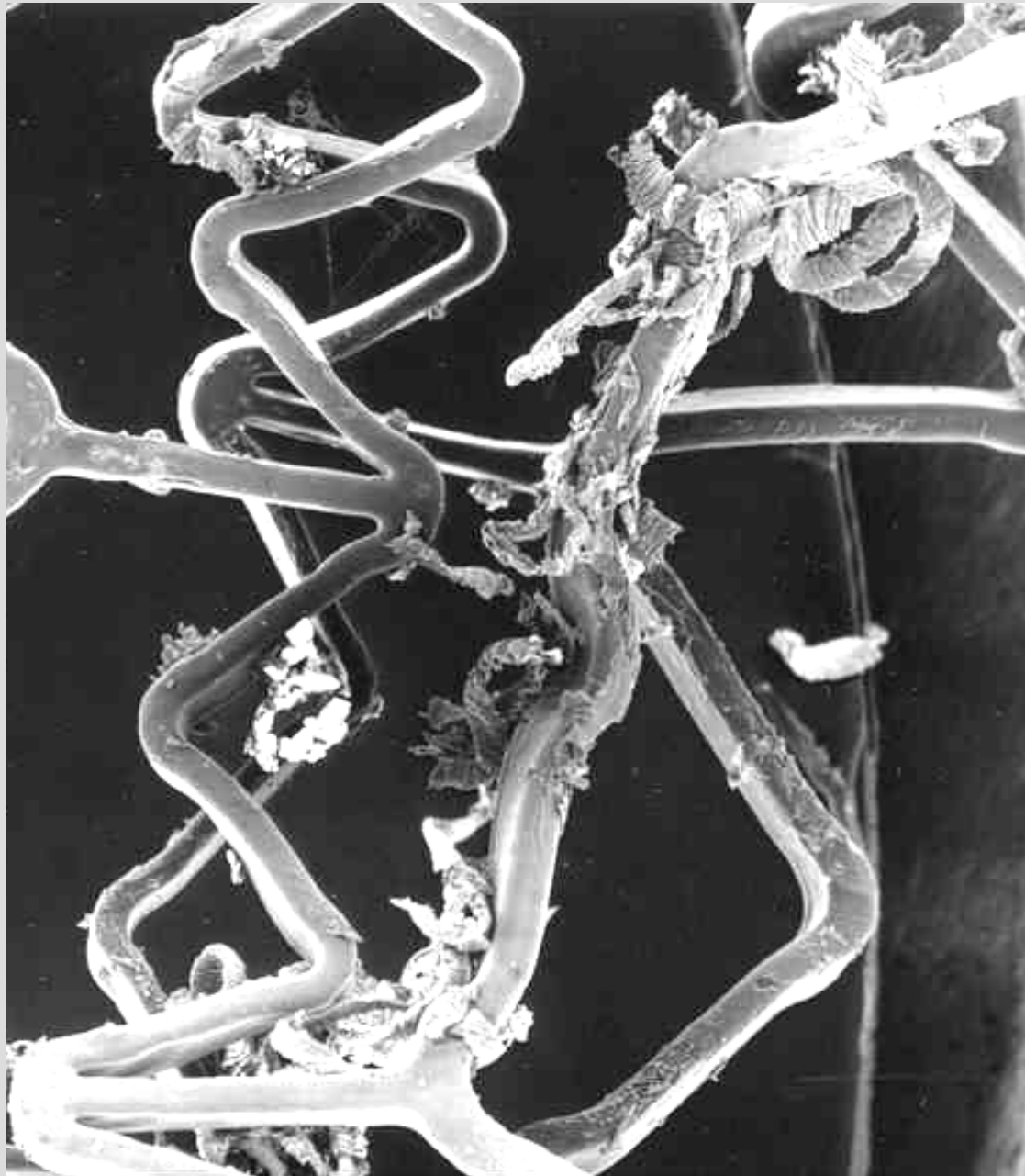


# Scanning Electron Microscopy after “crush” technique with “kissing” balloon post-dilatation

- ❑ 3.5 and 3.0 mm DES
- ❑ Kissing balloon post-dilatation with **4.0 mm main br and 3 mm side-br balloons @ 20 atmos five times (oversized, v high pressure and repeated)**
- ❑ Stents were separated, sputter coated, and imaged with SEM

Side-branch ostium after “crush” + “kiss” with large balloons and multiple inflations at 20 atmos

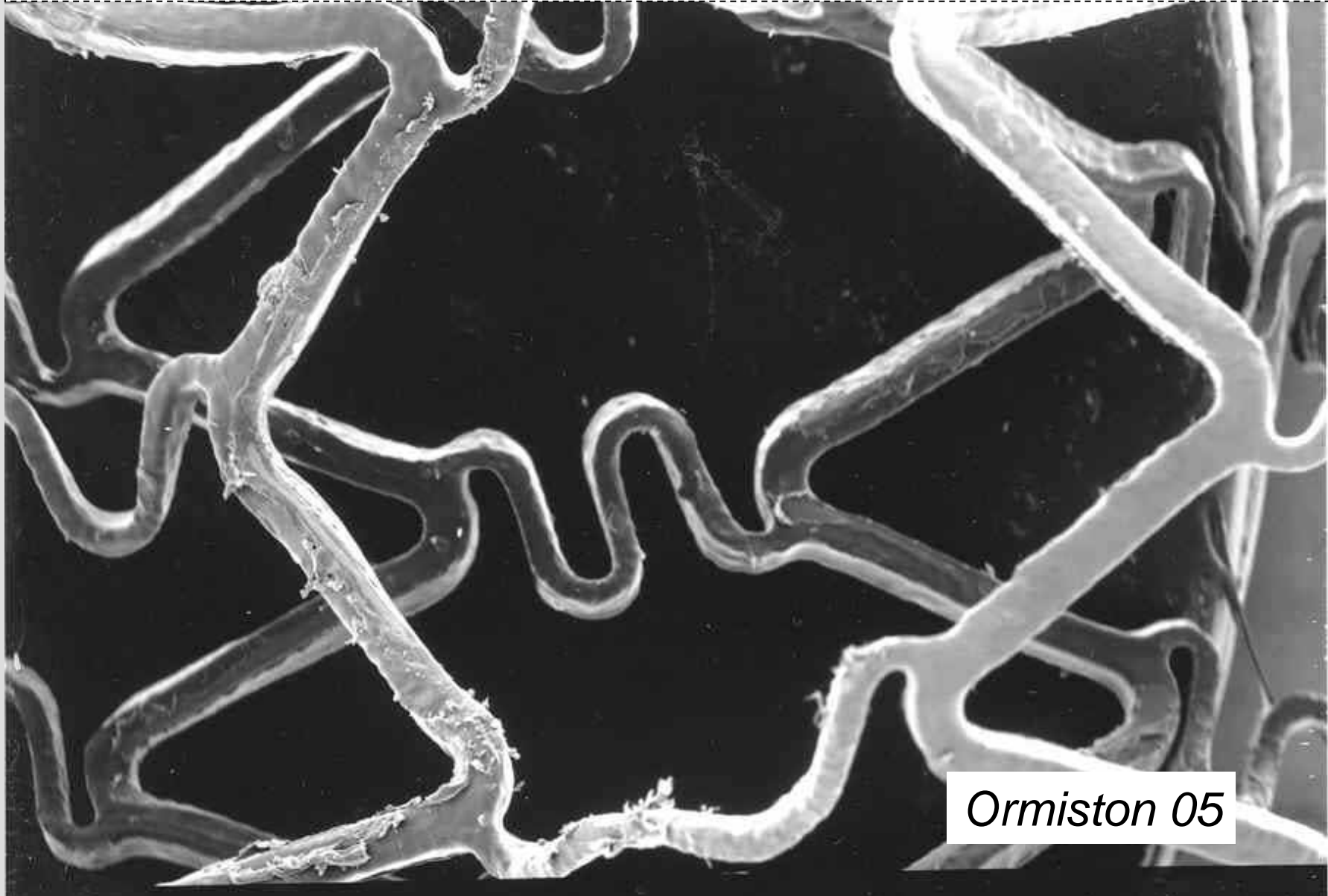




**Does  
polymer  
damage  
predispose  
to  
thrombosis  
and/or  
restenosis?**

*Ormiston 05*

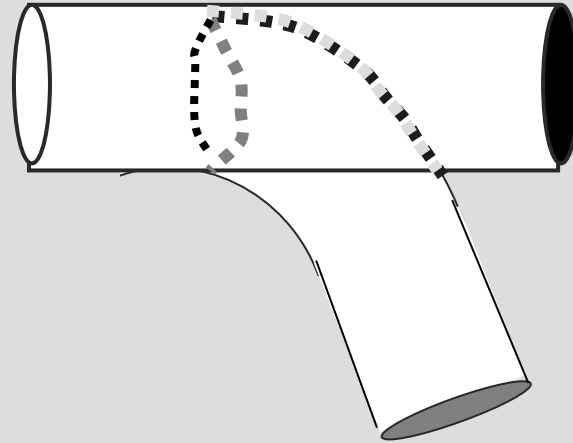
Side-branch ostium after “crush” and after single 10 atm  
“kissing” balloon post-dilatation- minimal polymer damage



**□ With repeated high pressure post-dilatation with oversized balloons, it is possible to damage polymers after “crush” technique**

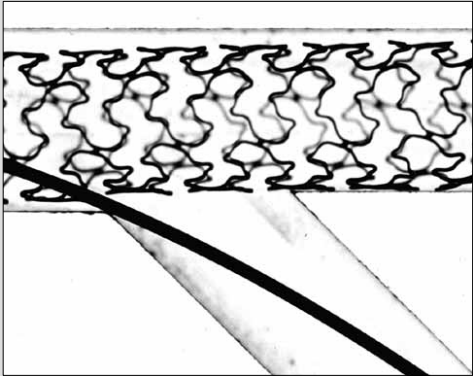
# The “Culotte” Technique-

Provisional side-br stenting in the DES era



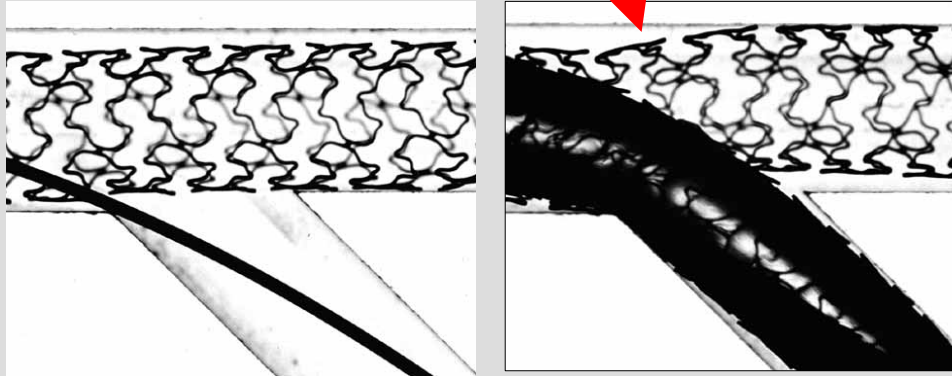
*Ormiston 05*

Culotte Stenting with Liberte (new Boston DES delivery platform)



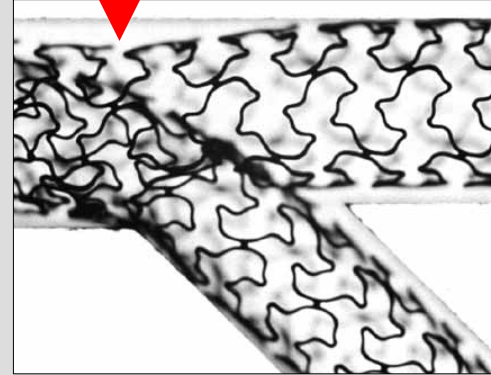
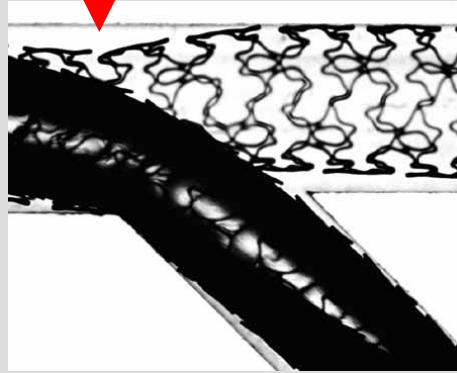
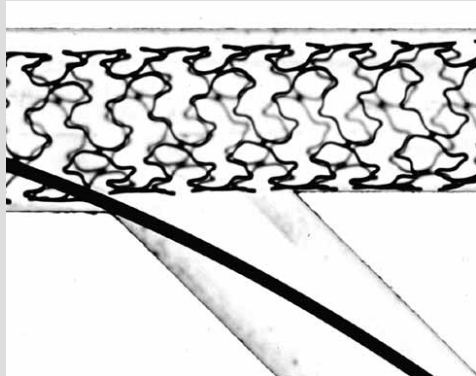
*Ormiston, 05*

When the side-branch stent is passed partially through the side of the main branch stent and deployed, distortion appears



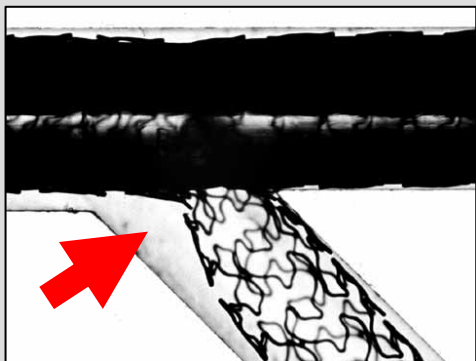
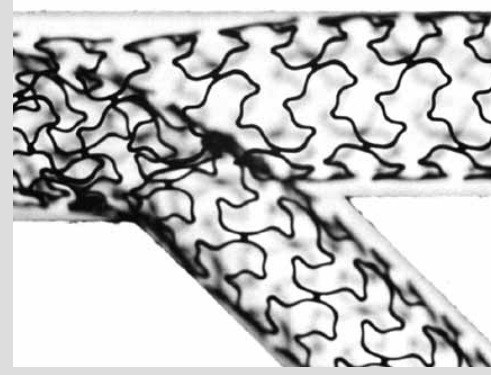
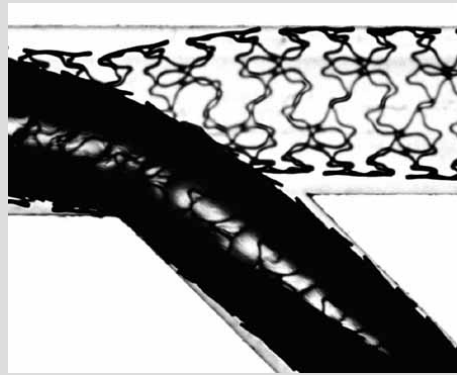
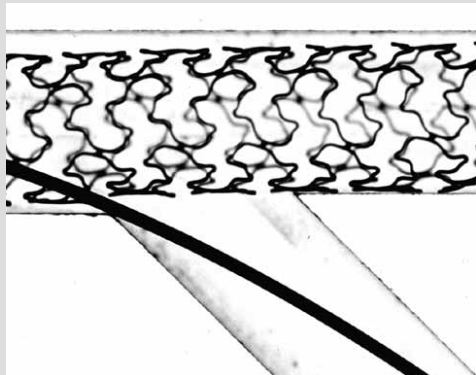


Culotte technique. The balloon is removed



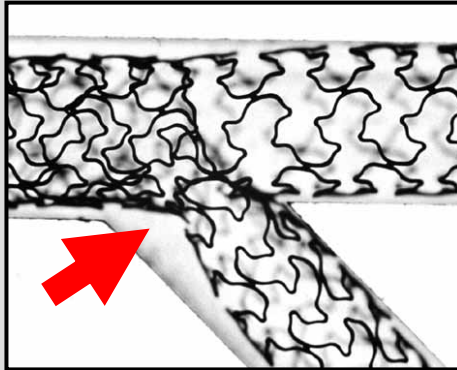
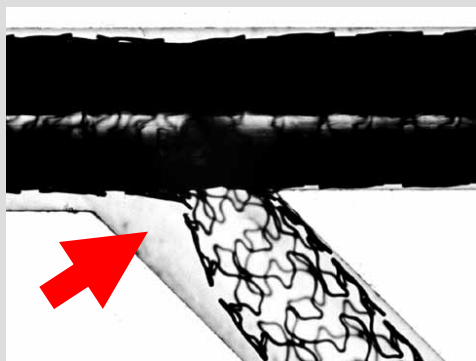
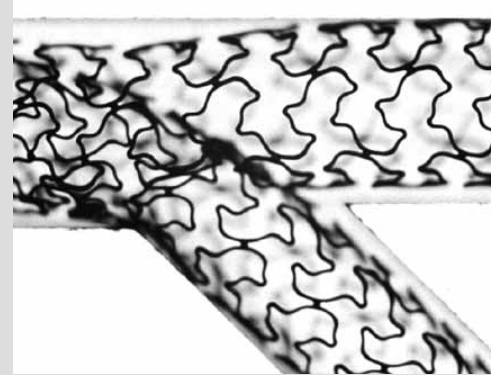
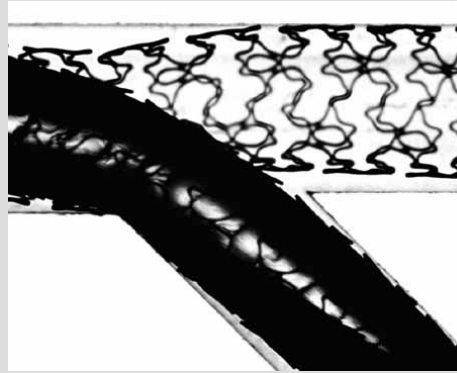
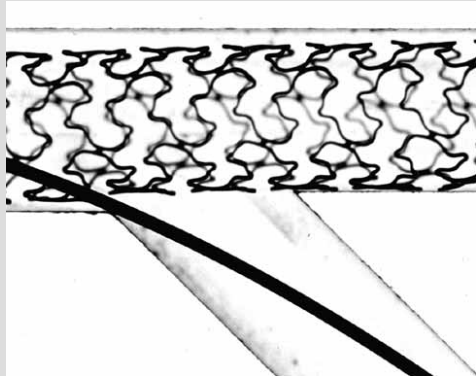
*Ormiston, 05*

Culotte. Main branch post-dilatation distorts the side-br ostium



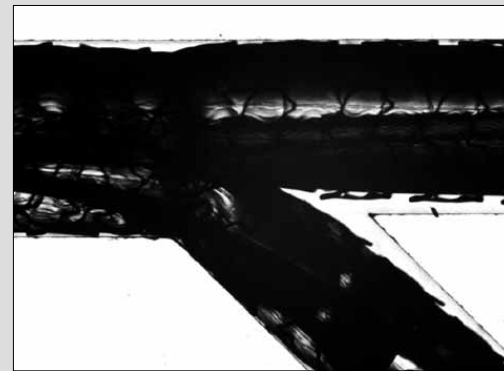
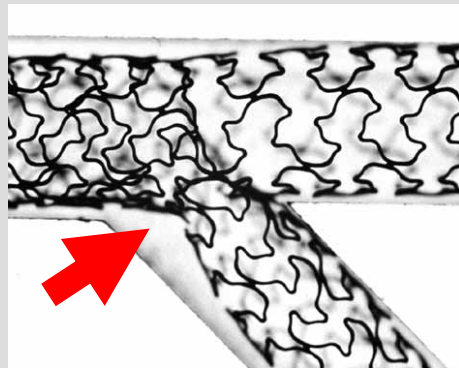
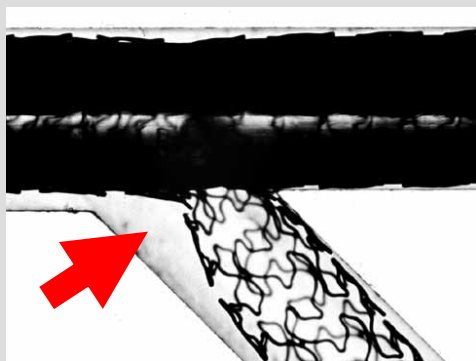
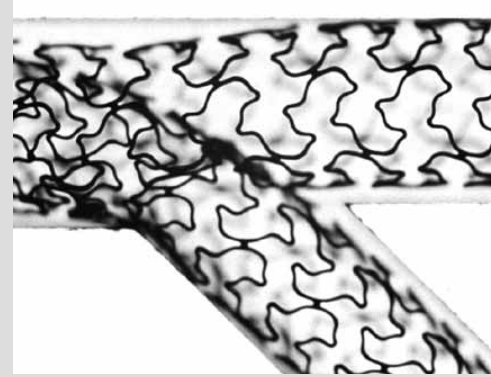
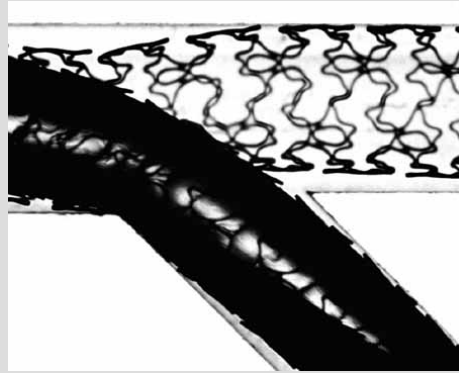
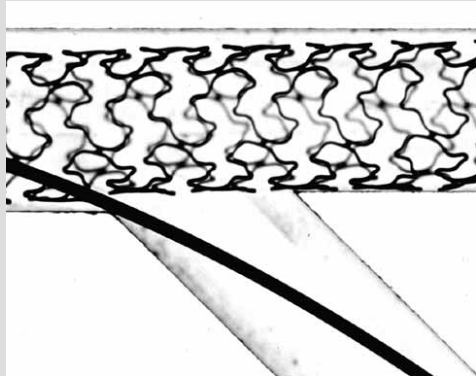
*Ormiston 05*

The main branch post-dilating balloon is removed

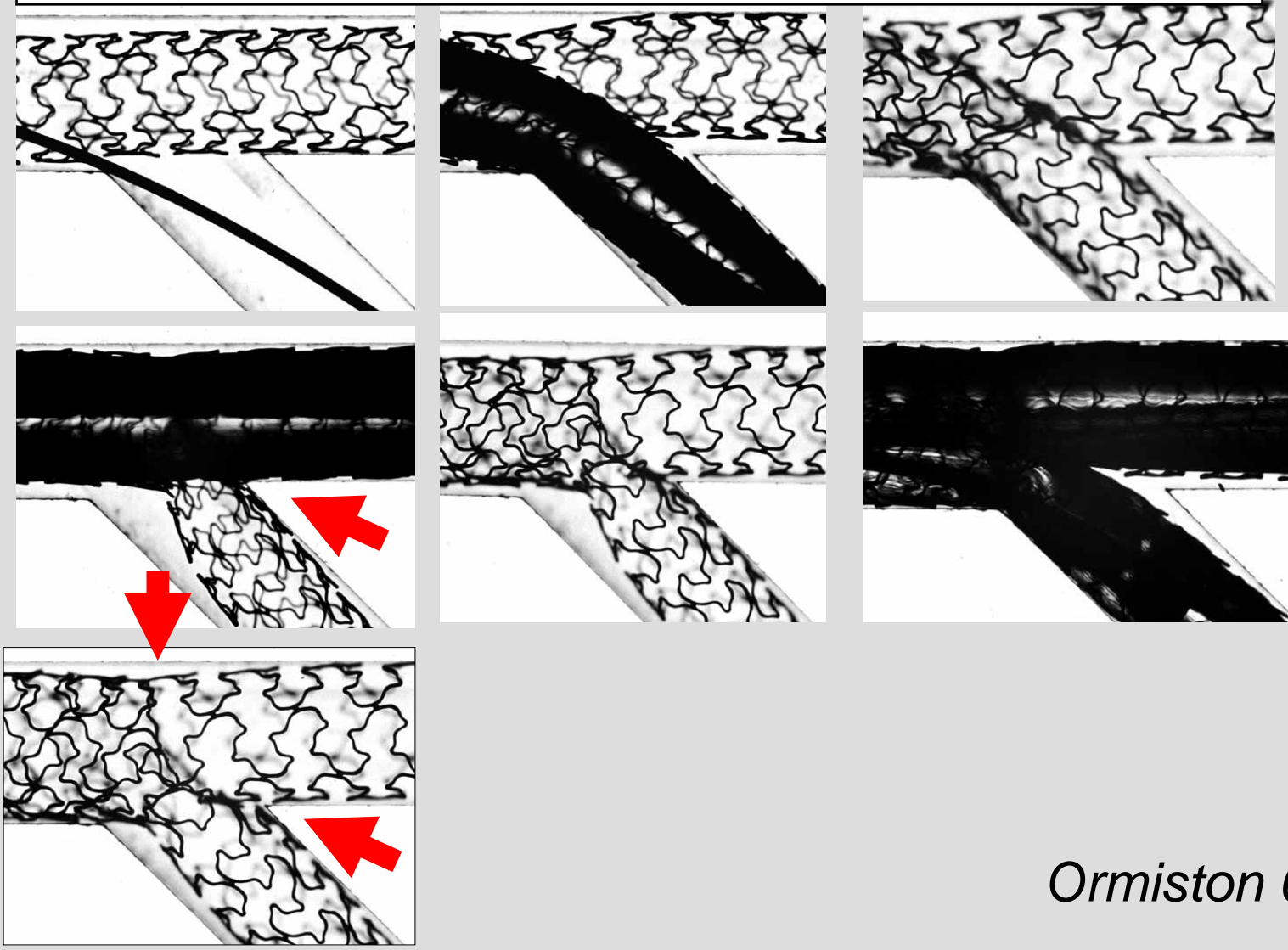


*Ormiston, 05*

**Culotte. Kissing balloon post-dilatation.....**



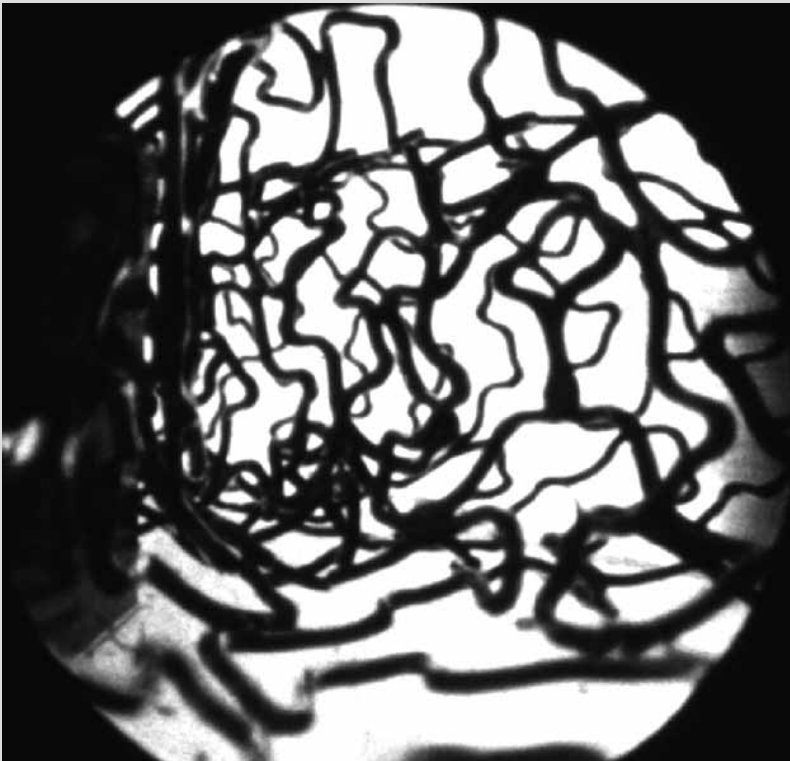
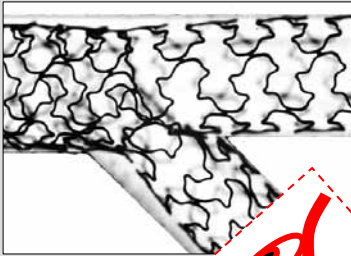
“Kissing” balloon post-dilatation corrects distortion, and fully expands the stent improving scaffolding and drug application to the ostium



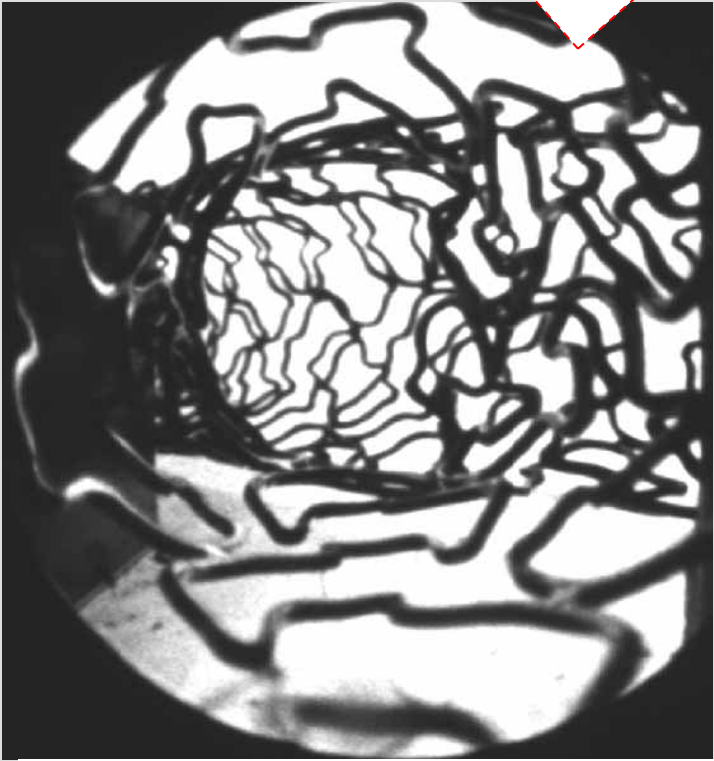
*Ormiston 05*



**“Kissing” balloon post-dilatation releases the side-branch from “jail” after “Culotte” with Liberte**

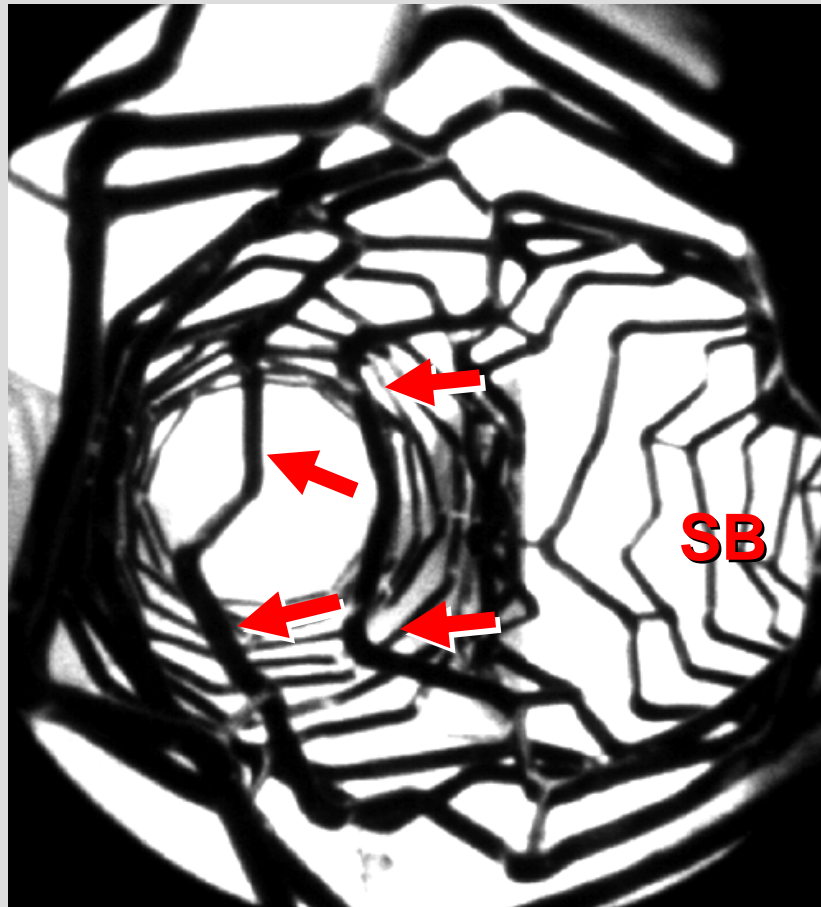
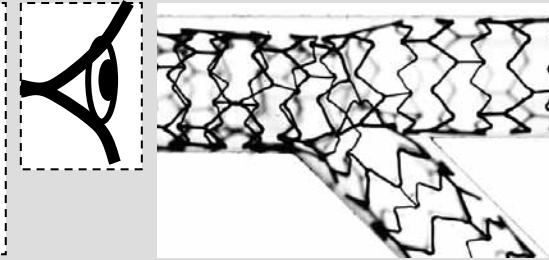


Side-branch is “jailed”

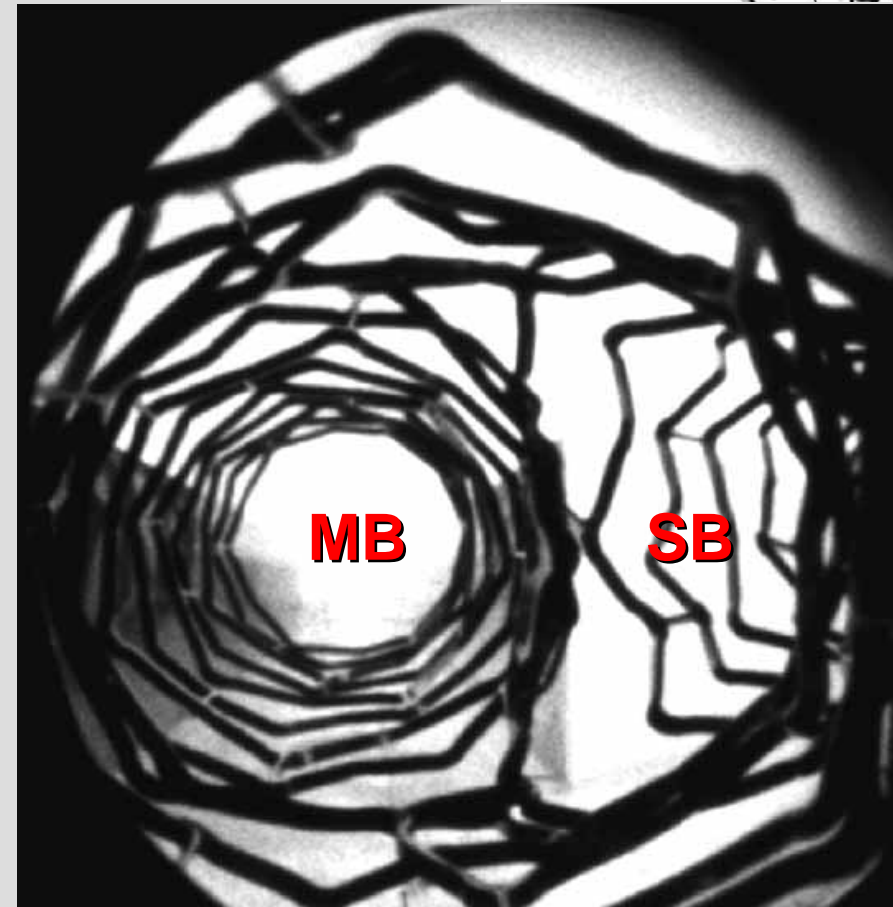


“Kissing balloon post-dilatation releases the side br from jail

After “culotte”, “kissing” balloon post-dilatation relieves main branch obstruction (Taxus Express stents)



Before “kiss”



After “kiss”

*Ormiston 05*

# Stent Distortion in Bifurcation Stenting

## -its prevention and repair

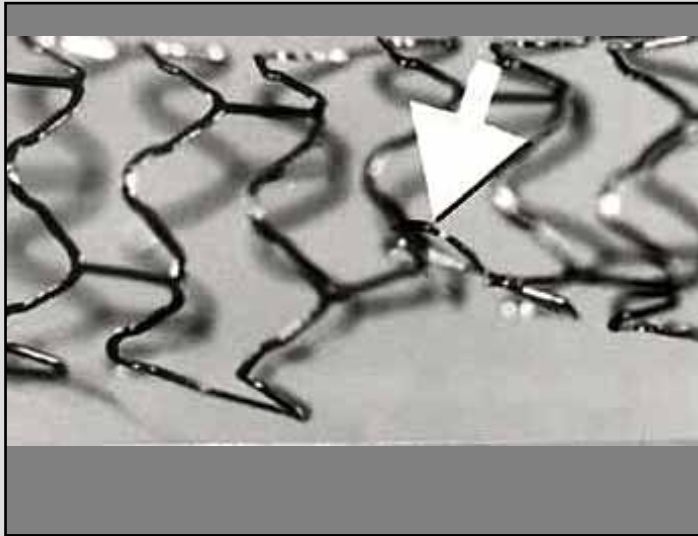
*Ormiston 05*



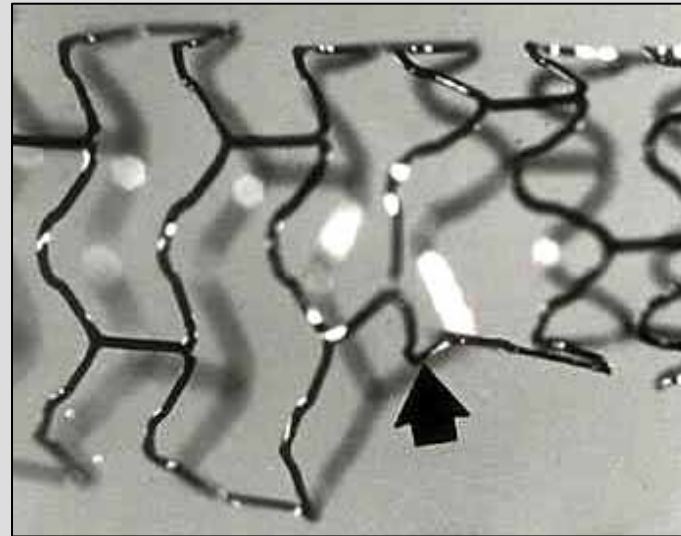
## **stent distortion may**

- predispose to SAT
- predispose to restenosis
- limit subsequent access

Distortion caused by dilatation through the side of a single stent



Distortion is repaired by kissing balloon dilatation



Ormiston et al  
Cathet Cardiovasc Interv  
1999;47:258-264.

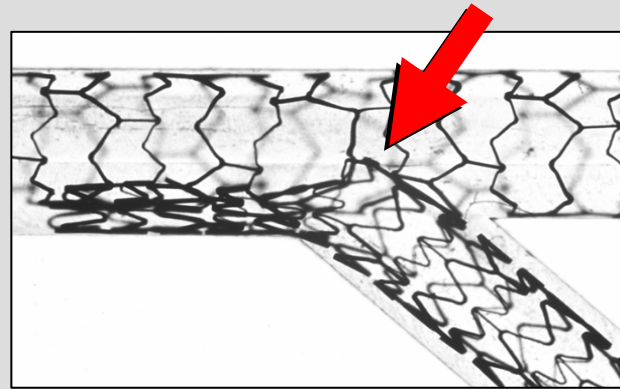
*Ormiston 05*

An undersized “kissing balloon” post-dilatation.....



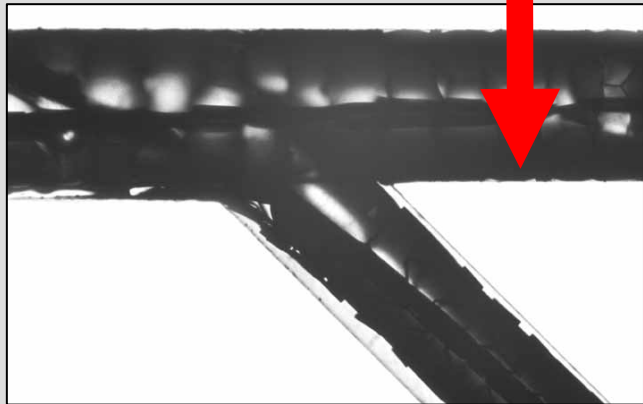
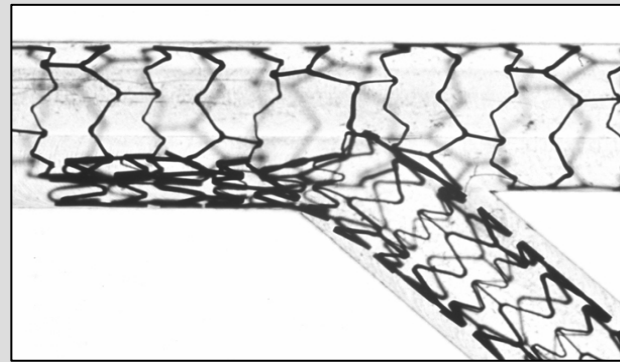
Ormiston CCVI

.....causes distortion after conventional "crush"



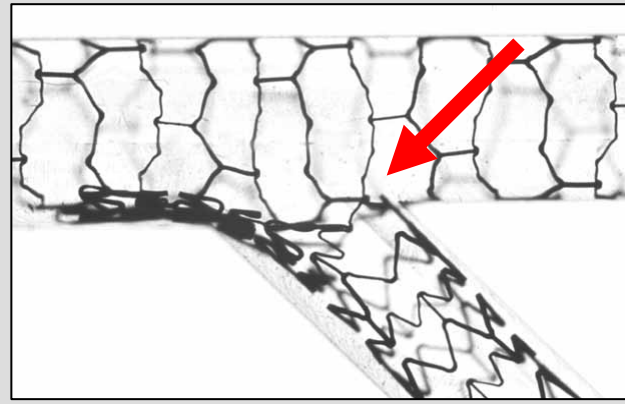
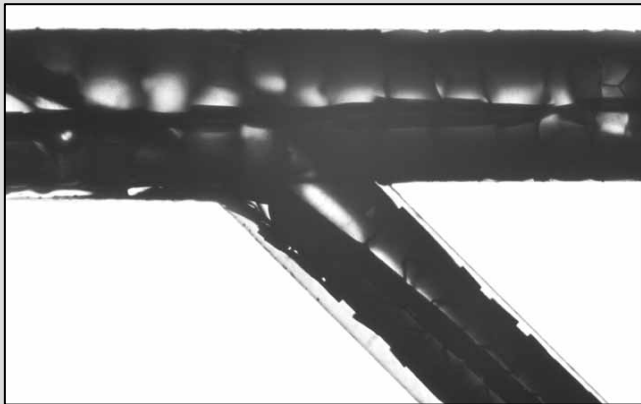
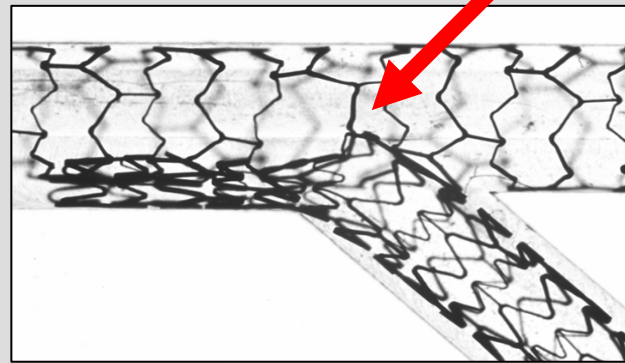
Ormiston CCVI (2004)

An appropriately sized main branch “kissing”  
balloon.....



Ormiston CCVI (2004)

.....repairs (or prevents) distortion



Ormiston CCVI (2004)

## “Kissing” Balloon Post-dilatation

After “External Crush” corrects distortion

**“A kiss is not just a kiss”**

**Antonio Colombo,  
Editorial CCVI, 2004**



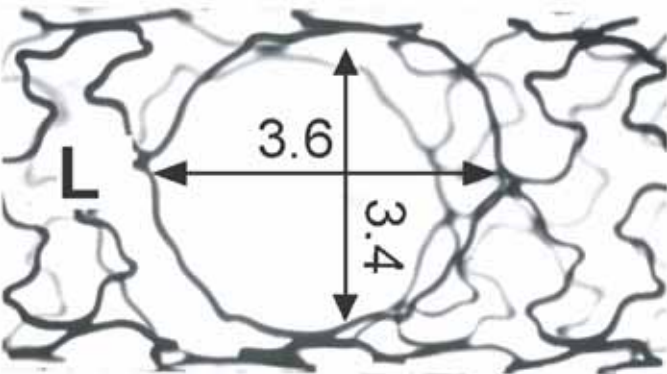
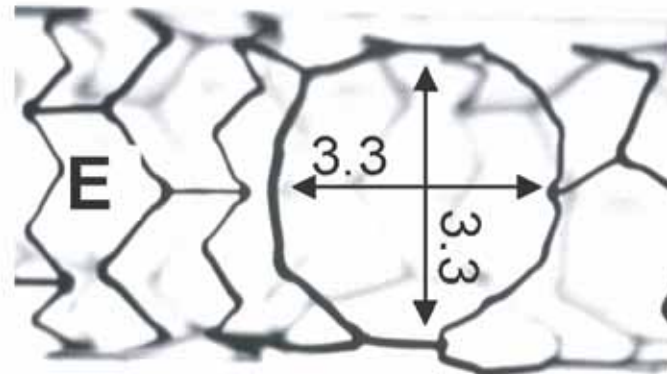
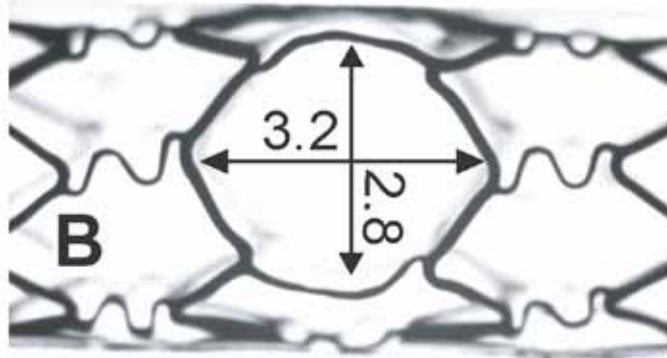
## Summary- Bifurcations with DES

- Drug-eluting stents are a major advance in treatment of bifurcation lesions
- There is no perfect solution for bifurcation stenting with DES
- “T” stenting has potential for gaps in scaffolding and drug application
- The “external crush” technique ensures coverage of the side-branch ostium without gaps but “jails” the side-br and has 3 layers of stent
- Kissing balloon post-dilatation corrects any main-br distortion, releases the side-br from “jail” and fully expands the stent at the side-br ostium after “crush”, “culotte” and “T” stenting

# Summary

- ❑ Kissing balloon post-dilatation corrects any main-br distortion, releases the side-br from “jail” and fully expands the stent at the side-br ostium after “crush”, “culotte” and “T” stenting
- ❑ Undersized main branch “kissing” balloon post-dilatation after “external crush”, “culotte” and “T” stenting causes stent distortion
- ❑ Very high pressure, repeated oversized post-dilatation after crush causes polymer disruption
- ❑ Length of overlap (3layers) with crush should be limited

## Maximum cell size after side-br dilatation



Bx Velocity  
(Cypher)

Express  
(Taxus Express)

Liberte  
(Taxus Liberte)

*Ormiston CCVI in press 05*