



Summit TCT  
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# Stent Thrombosis in Bifurcation Stenting

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# Why Are Bifurcation Lesion More Prone to Thrombosis



Pathological studies suggest that arterial branch points are foci of **low shear** and **low flow velocity** and are sites predisposed to the development of atherosclerotic plaque, thrombosis and inflammation



# NHLBI Dynamic Registry

	Bifurcation n=321	Non-bifurcation n=2,115	p
<b>Angiographic success</b>	<b>86.0%</b>	<b>93.5%</b>	<b>&lt;0.001</b>
<b>Side-branch closure</b>	<b>7.3%</b>	<b>2.3%</b>	<b>&lt;0.001</b>
<b>In-hospital MACE</b>	<b>7.2%</b>	<b>5.0%</b>	<b>&lt;0.001</b>
<b>One-Year MACE</b>	<b>32.1%</b>	<b>25.7%</b>	<b>&lt;0.05</b>

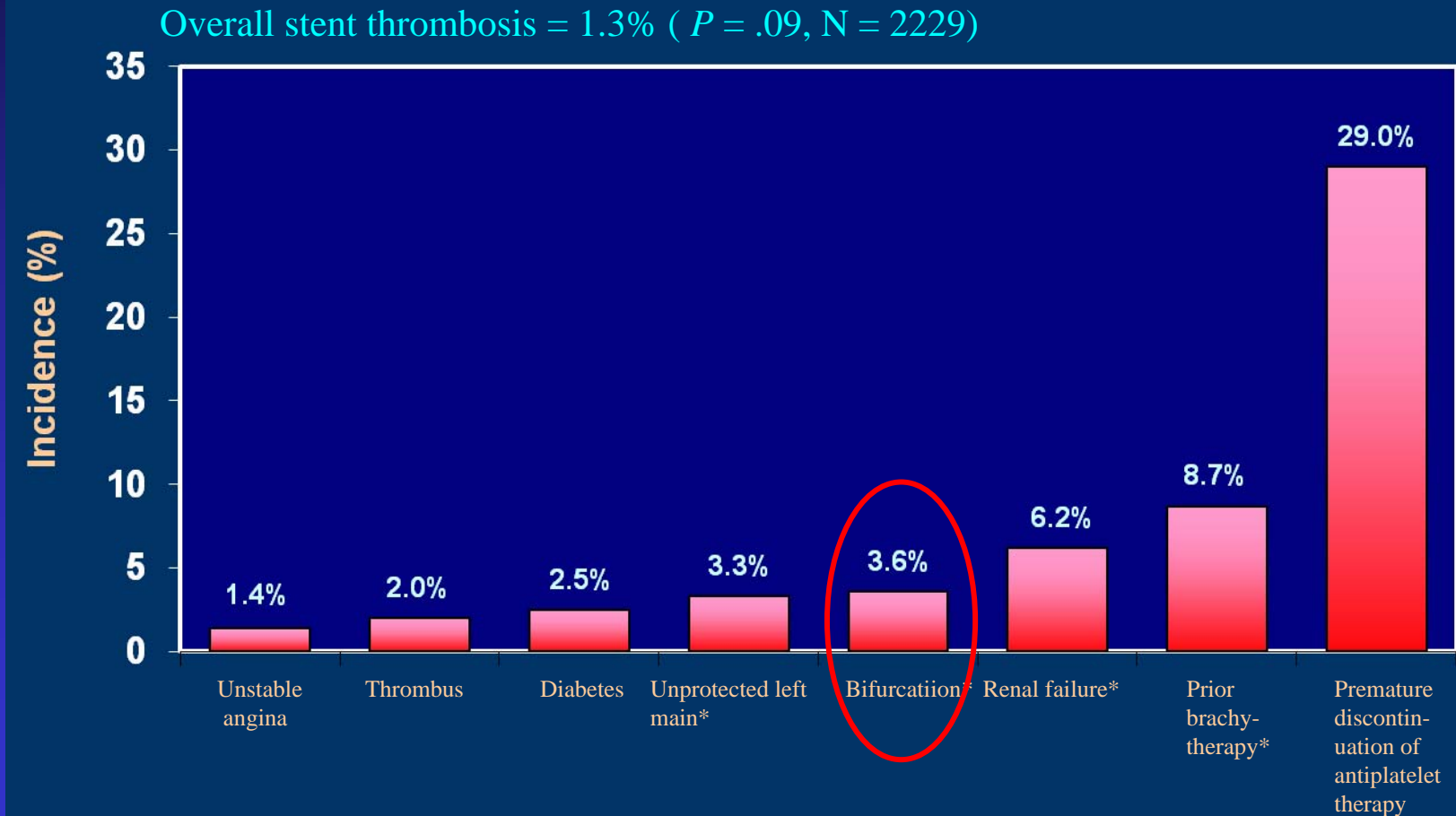


Suwaidi et al AJC 2001

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# Predictors of Stent Thrombosis After DES Implantation



Holmes DR Rev Cardiovasc Med 2007; 8: S11

Iakovou I et al JAMA 2005; 293: 2126

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# J CYPHER: Predictors of Definite and Probable Stent Thrombosis Through 1-Year

Factors	OR 95% CI	P value
2 stent approach in bifurcation lesions	2.05 (1.22-3.30)	0.0085
Hemodialysis	2.04 (1.22-3.16)	0.009
Emergency procedure	1.73 (0.97-2.82)	0.006



J CYPHER CCT 2008

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# ARTS II

The clinical outcome of percutaneous treatment of bifurcation lesions in multivessel coronary artery disease with the sirolimus-eluting stent: insights from the Arterial Revascularization Therapies Study part II (ARTS II)

- 5 cases of ST (1.5%) occurred in a total of 465 bifurcations in 324 pts treated with 1 stent. 4 were subacute ST, with 3 bifurcation lesions having had a poor angiographic result at end of procedure.
- The only case of late ST occurred in a nonbifurcation lesion



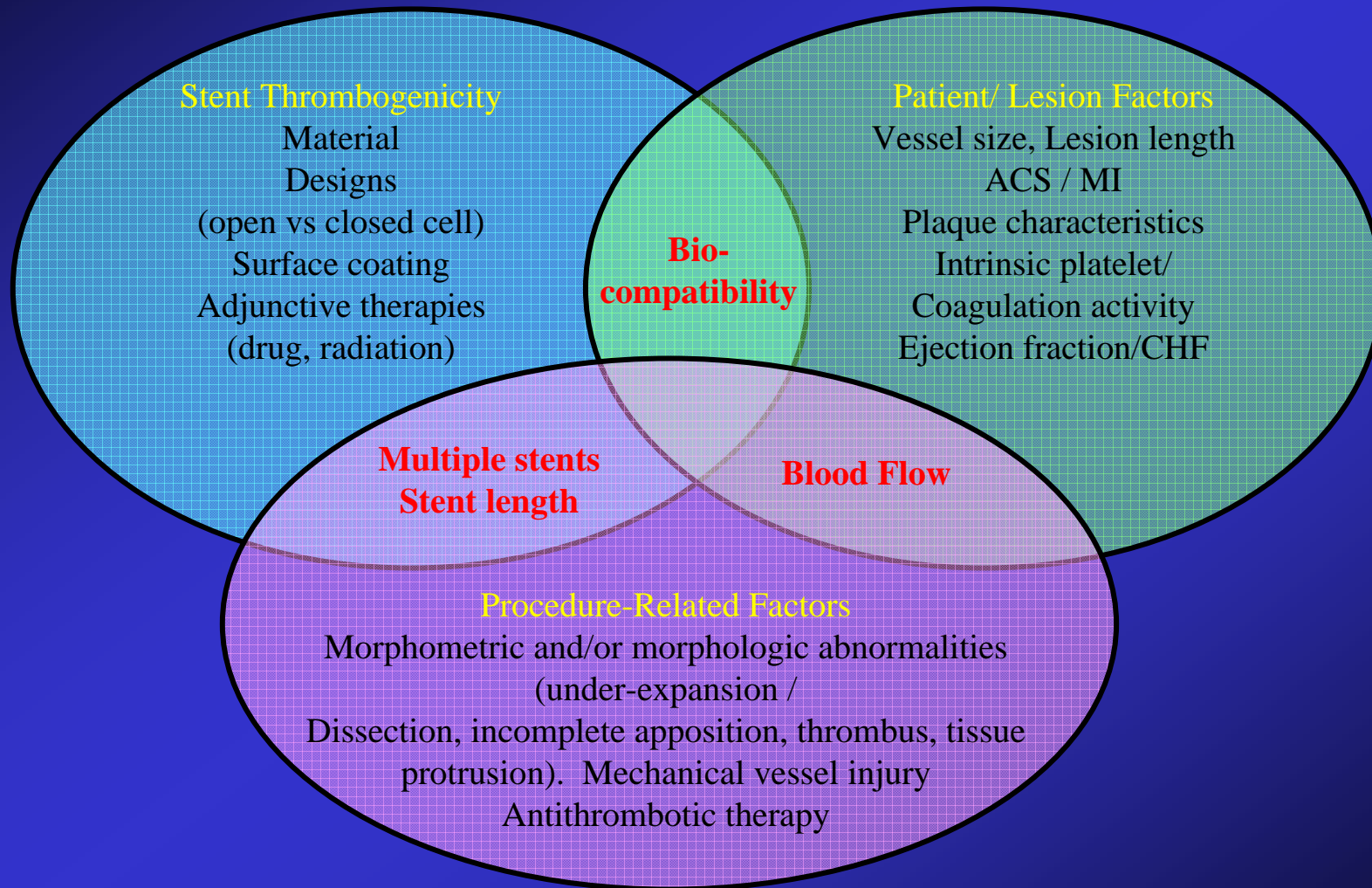
Tsuchida K et al *Euro Heart J* 28: 433-442

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# Multifactorial Causes of Stent Thrombosis



Keneiakes DK et al *Rex Cardiovasc Med* 2004; 5: 9-15

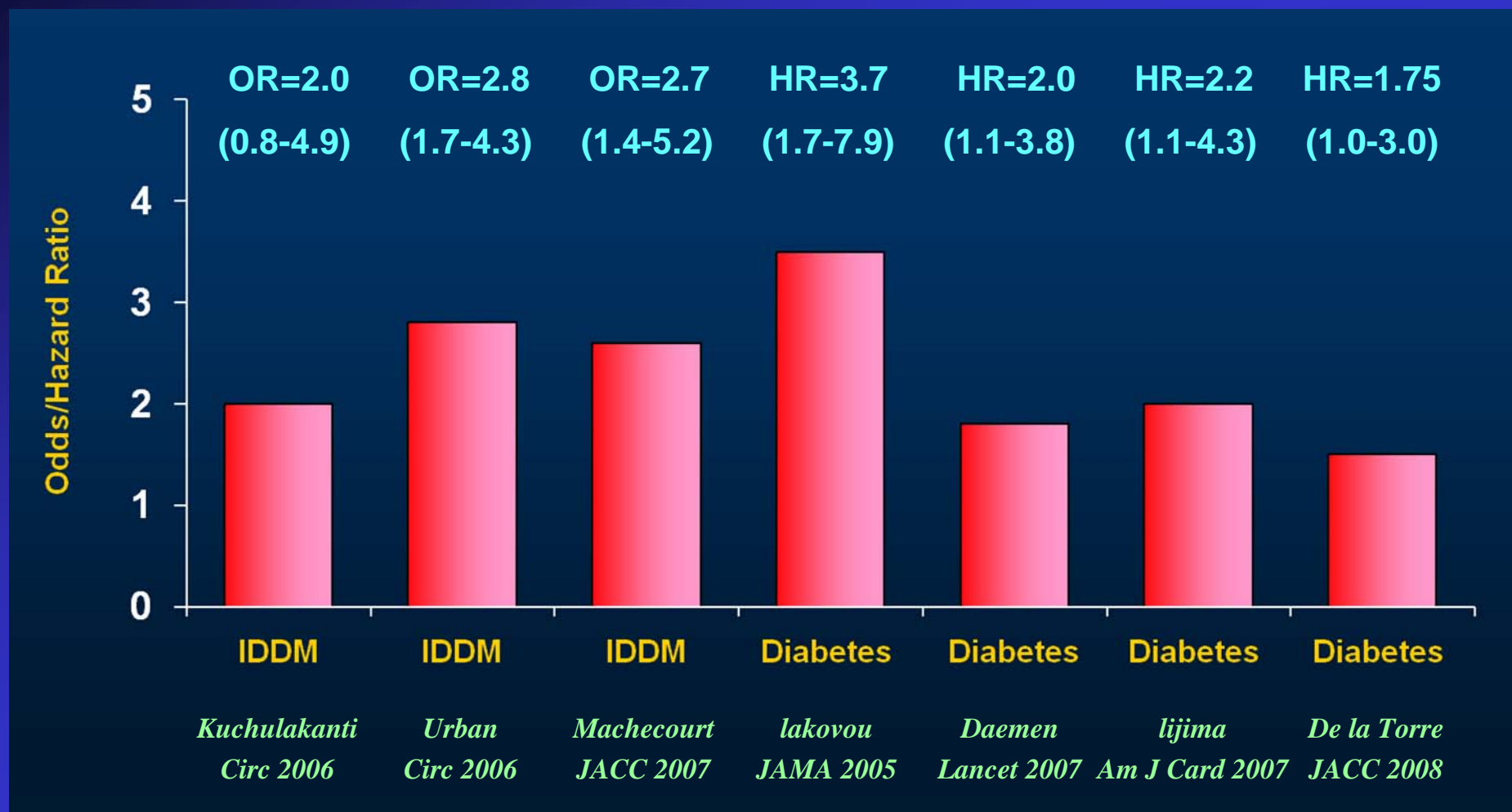




# Patient/ Lesion Factor



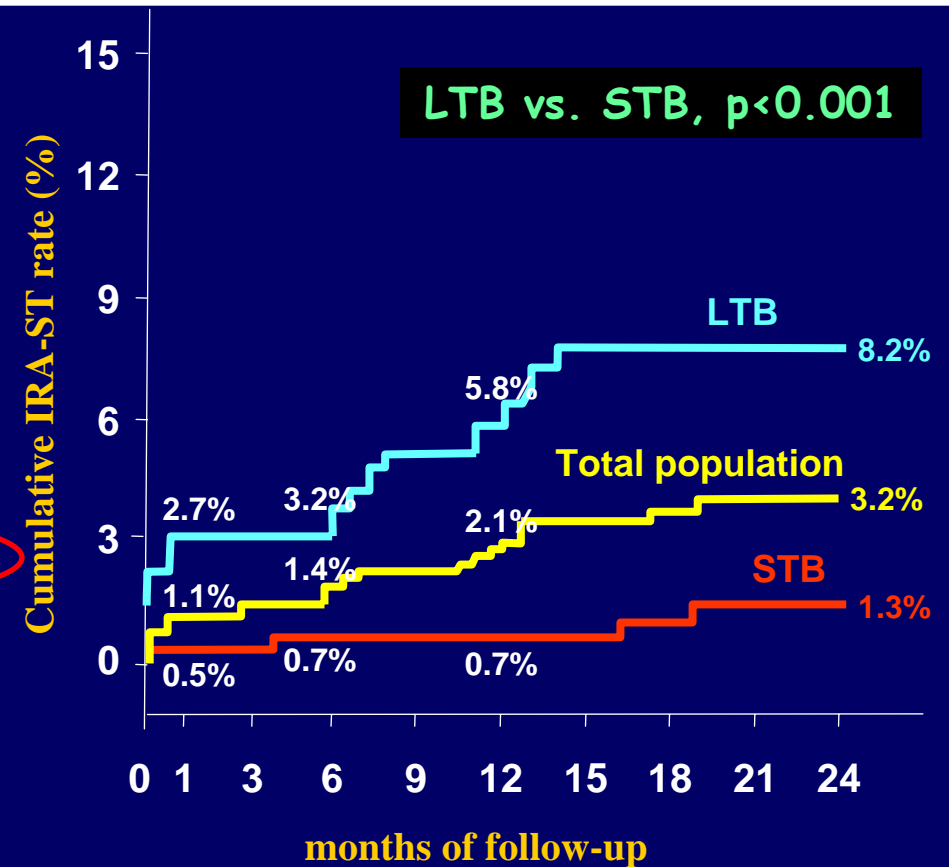
# Diabetes as Predictor of Stent Thrombosis



# Impact of Bifurcation Lesion on Risk of Stent Thrombosis With DES in Pts With STEMI

## Independent Predictors of ST

Variable	Harzard Ratio	95% CI
Age	0.6	0.4-0.8
Index ST	6.2	2.1-18.9
<b>Bifurcation</b>	<b>4.1</b>	<b>1.6-10.0</b>
Thrombectomy	0.1	0.01-0.8
Large thrombus	8.7	3.4-22.5



Sianos G et al J Am Coll Cardiol 2007; 50: 573-83

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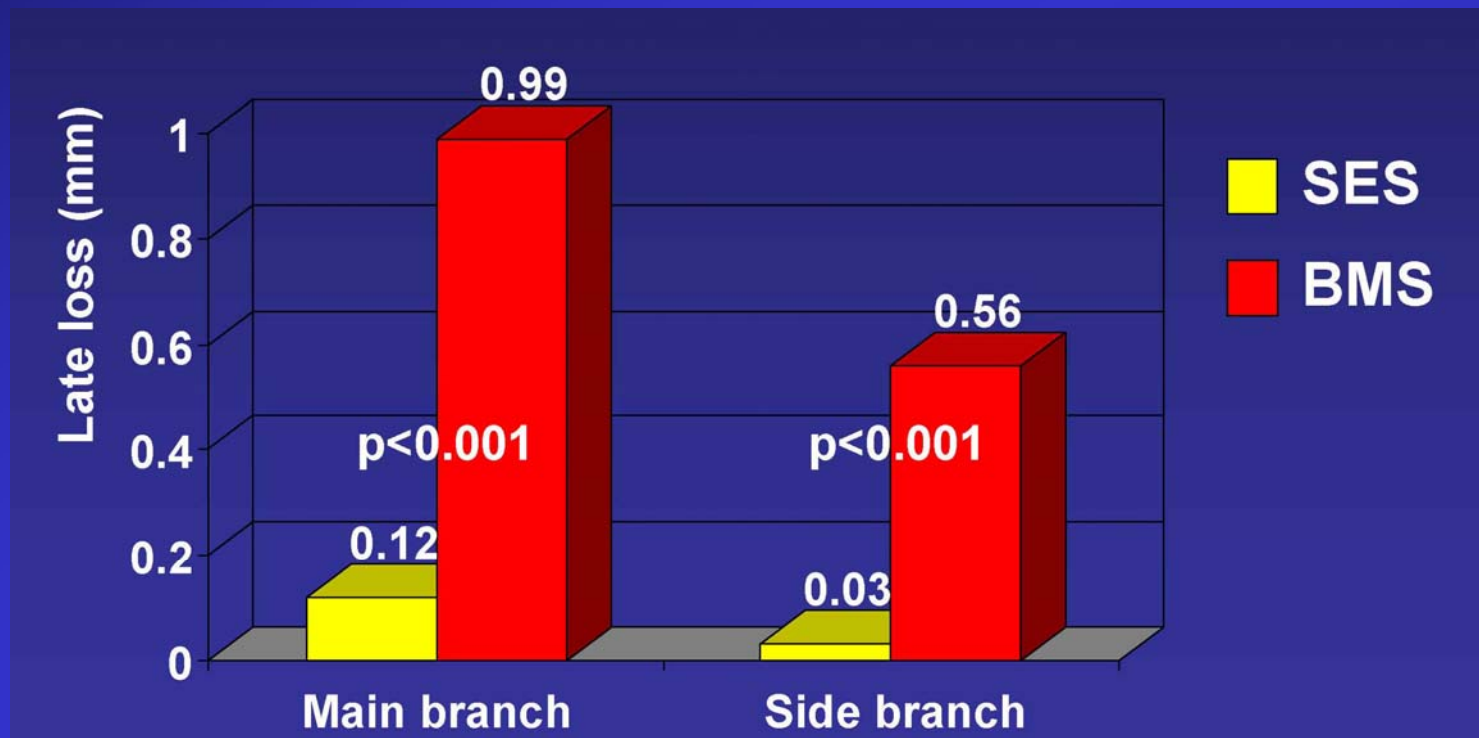


# DES vs BMS In Bifurcation Stenting



# SCANDSTENT: DES vs BMS

- SCANSTENT: randomised study comparing SES with BMS implantation in patients with complex CAD
- Subgroup analysis of those with a bifurcation (n=126)

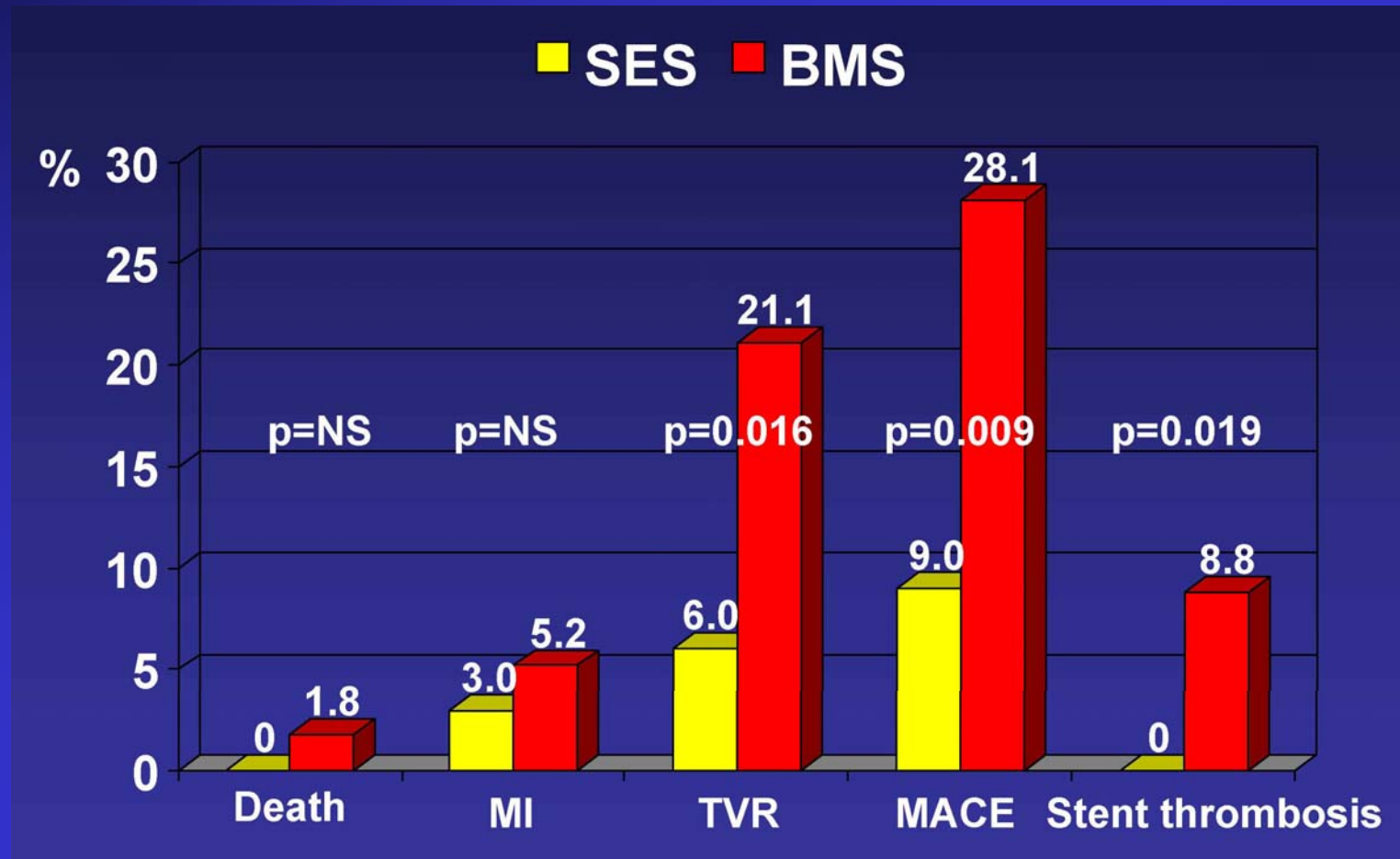


Thiesen et al AHJ 2006; 152: 1140-1145





# SCANDSTENT: Clinical Outcomes in Bifurcation Lesions

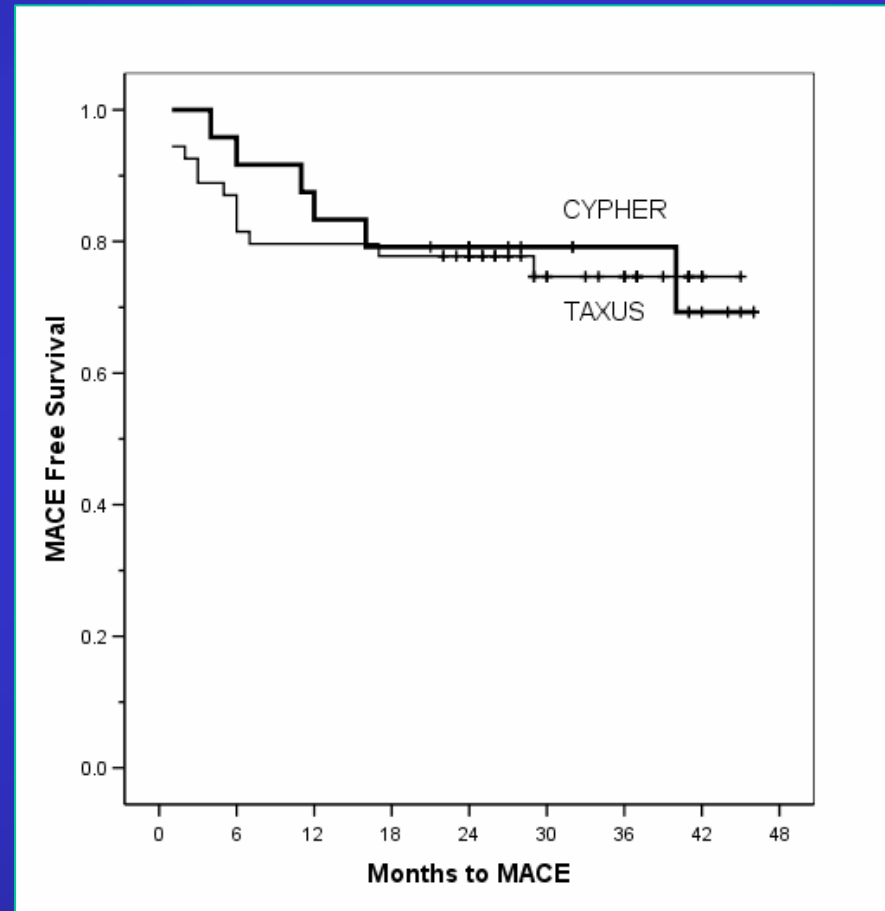


Thiesen et al AHJ 2006; 152: 1140-1145



# Cypher vs Taxus In Bifurcation Stenting: Long-term Clinical Follow-up

- N= 78 (CYPHER=24; TAXUS=54)
- 80 bifurcation lesions (CYPHER=24; TAXUS=56)
- Median follow-up period: 32 (range: 21 to 48) months
- The overall long-term MACE rates for the CYPHER & TAXUS gps were **25%** & **24%** respectively
- Two sudden deaths occurred at 6 & 17 mths in the TAXUS gp (no post-mortem examination performed)



Lee CH, Tan HC et al Int J Cardiol 2007

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# Risk of Stent Thrombosis When 2 stents versus 1 stent Is Used



# 2-Stent vs 1-Stent Bifurcation Stenting

	2-stent (n=53)	1-stent (n=39)	P
SB Residual Stenosis (%)	7.4 ± 10.9	23.4 ± 18.7	<0.001
Immediate Success	87%	92%	
In-hospital MACE	13%	0%	<0.05
Restenosis	62%	48%	NS
Target lesion revascularisation	38%	36%	NS
6 Mth MACE	51%	38%	NS



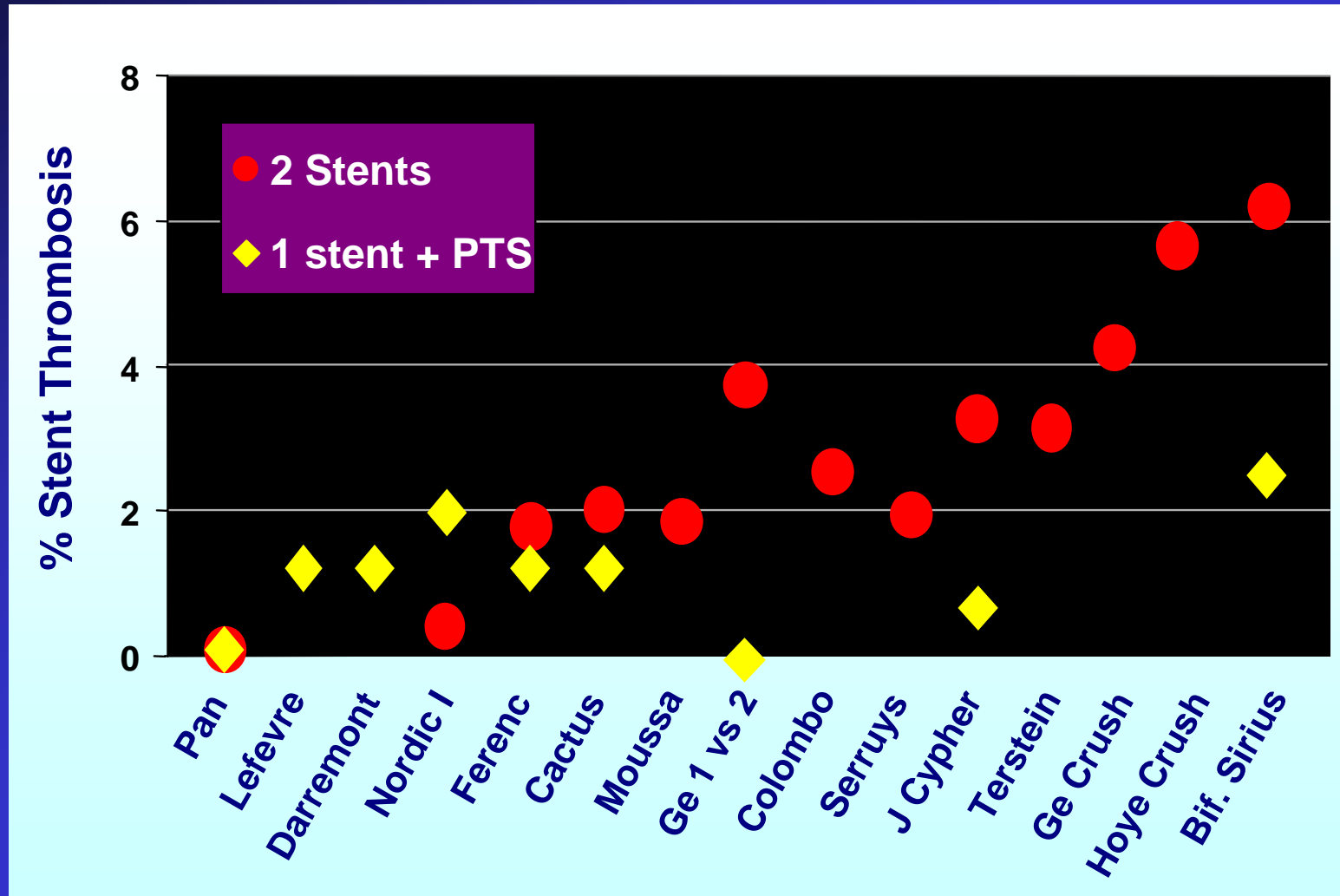
Yamashita et al JACC 2000; 35: 1145-51

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# Safety of DES: Stent Thrombosis



TCT 2008

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# Nordic I Bifurcation Study

- Multicenter study of the SES in bifurcations
- Randomised to a provisional versus a 2-stent strategy

6-months Clinical FU	Single stent n = 207	MB + SB Stent n=206	P value
Death	1	1	1.0
MI (%)	0	0.5	0.3
TLR (%)	2	1	0.4
TVR (%)	2	2	1.0
MACE (%)	3	3	ns
Stent thrombosis (%)	0.5	0	0.3

Only 1 patient had definite ST, and he was treated with 1 stent



Steigen TK et al *Circulation* 2006; 114: 1955-61

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# NORDIC I: Clinical Endpoints After 14 Mths

	MV	MV + SB	p
Definite stent thrombosis, n (%)	2/199 (1.0)	1/196 (0.5)	ns
Probable stent thrombosis, n (%)	2/199 (1.0)	0/196 (0)	ns
Possible stent thrombosis, n (%)	1/199 (0.5)	0/196 (0)	ns
Overall stent thrombosis, n (%)	4/199 (2.0)	1/196 (0.5)	ns
Total death, n (%)	5/207 (2.4)	2/206 (1.0)	ns
Cardiac death, n (%)	3/207 (1.4)	2/206 (1.0)	ns
Myocardial infarction, n (%)	4/199 (2.0)	2/196 (1.0)	ns
TLR, n (%)	13/199 (6.5)	11/196 (5.6)	ns
TVR, n (%)	15/199 (7.5)	12/196 (6.1)	ns
MACE, n (%)	19/199 (9.5)	16/196 (8.2)	ns



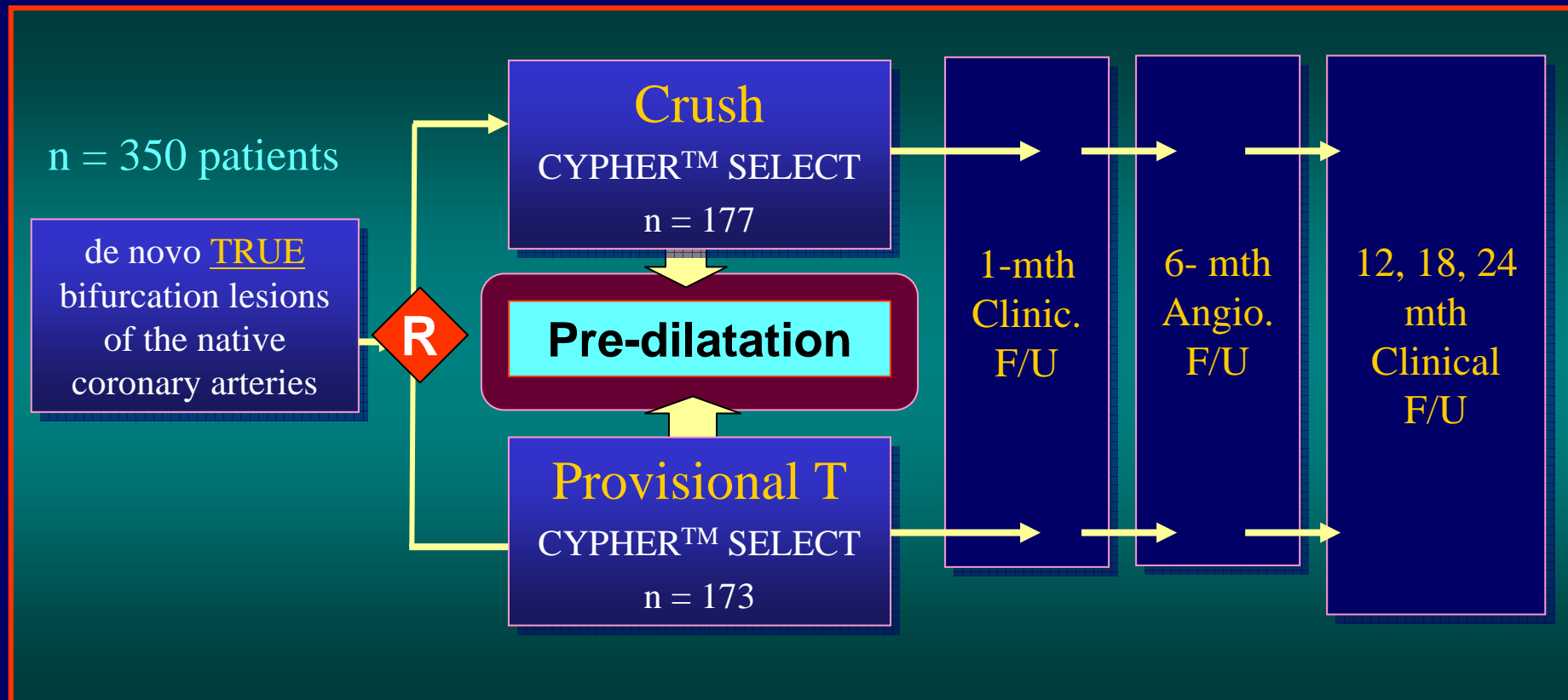
Jensen JS et al EuroInterv 2008; 4: 229-233

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# CACTUS: Study Design and Time Frame



Dual antiplatelet therapy was recommended in all pts for at least 6 months



Colombo A et al *Circulation* 2009; 119: 71-78

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# CACTUS: Stent thrombosis

	Total	Acute (first day)	Subacute (days 2-30)	Late (days 31-180)
Crush (n=177)	3 (1.7%)	1 (0.5%)	2* (1.1%)	0
Prov. T (n=173)	2 (1.1%)	0	1 (0.5%)	1 (0.5%) (definitive)

*p = 0.62 for comparisons between crush and prov.-T*

*\* One patient did not take thienopyridine therapy after discharge*



Colombo A et al *Circulation* 2009; 119: 71-78

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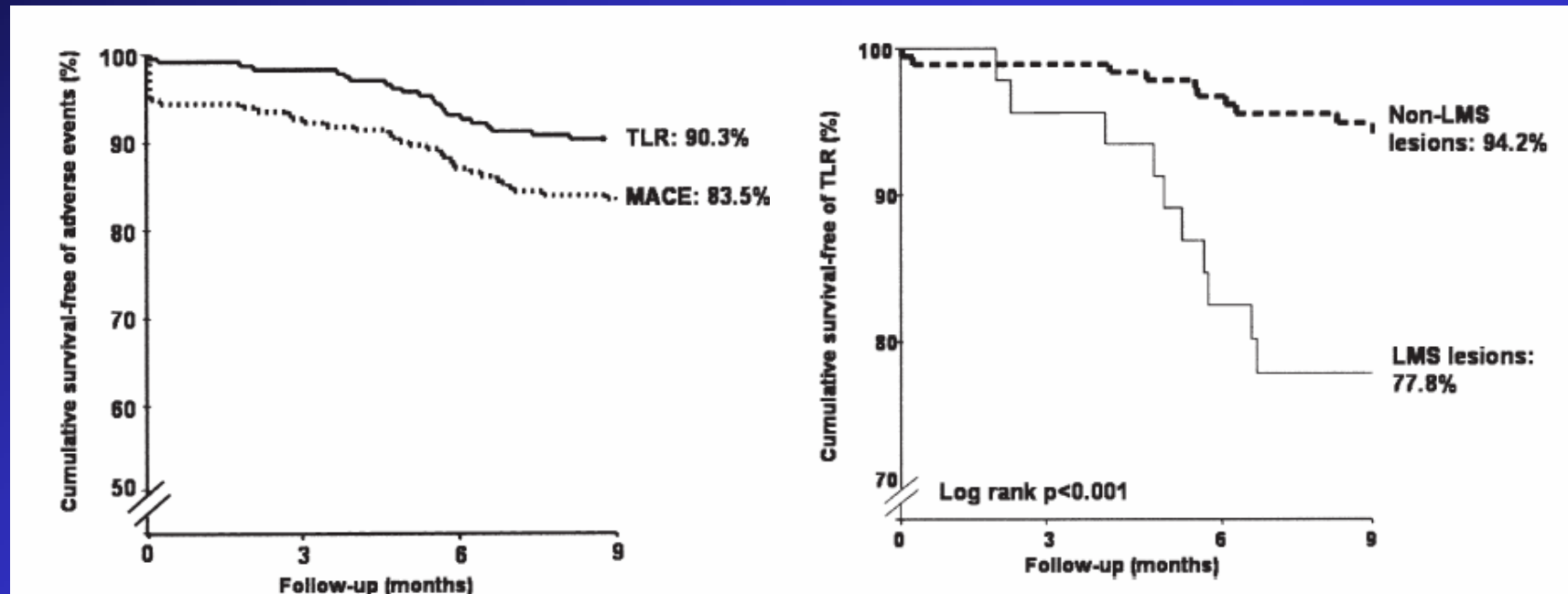


# Pitfalls of 2-Stent Stenting Techniques





# Long Term Outcomes After Stenting of Bifurcation Lesions with the “Crush” Technique



- At 9 mths, incidence of post-procedural stent thrombosis was 4.3%
- Only independent predictor of TLR was **left main stem** therapy (OR 4.97; 95% CI 2.00 to 12.37, p=0.001)



Hoye A et al J Am Coll Cardiol 2006; 47: 1949-58

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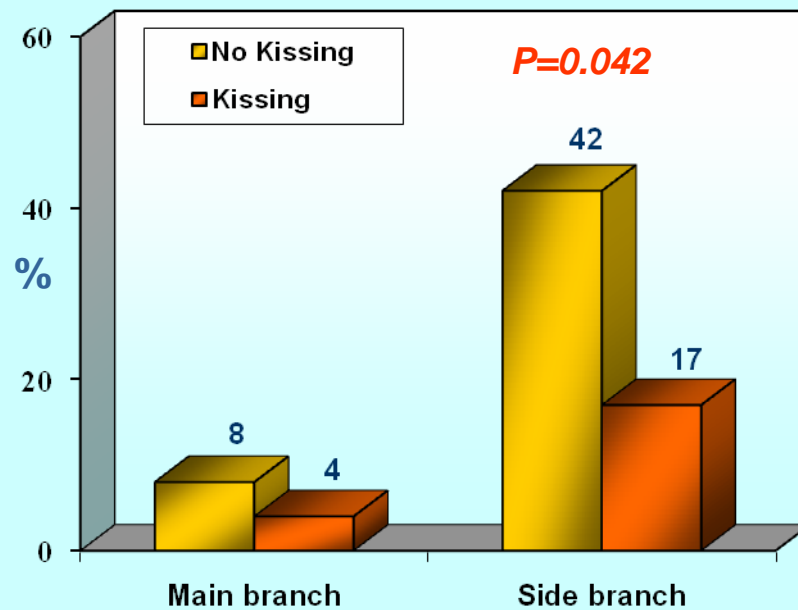


One regret  
that I'm  
determined  
not too  
have,  
is that  
I did not

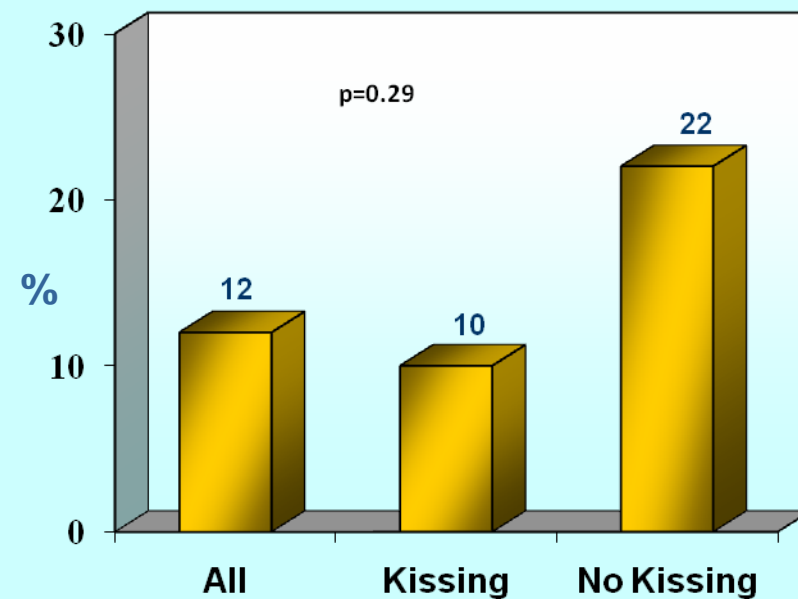


# Kissing Ballooning is Crucial in Crush Technique

6-mo restenosis rate  
(Colombo A, Ital Heart J 2005)



6-mo TLR  
(Lenox Hill, TCT 2004)



# Final Kissing Balloon Inflation by Classic Crush Stenting Did Not Improve the Clinical Outcomes for the Treatment of Unprotected Left Main Bifurcation Lesions: The Importance of Double-Kissing Crush Technique

- Unsatisfactory kissing rate (>20% residual stenosis) in the Classic Group was significantly higher (26.3% vs 5.9%)
- SB restenosis rate (42.1% vs 5.9%,  $p=0.01$ ) and MACE (42.1% vs 5.8%,  $p=0.001$ ) higher in Classic Group



SL Chen et al Cathet Cardiovasc Intervent 2008; 71: 166-172

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# Conclusions

- Stenting of bifurcation lesions is associated with an increased risk of stent thrombosis, even in DES era
- Risk is not greater with DES compared with BMS
- Risk is not greater when 2 stents versus 1 stent is used
- Implanting 2 stents always demands more attention and expertise to obtain the best result in both MB and SB
- Selection of appropriate diameter and length of stent to both optimally cover the target lesions and appropriate expansion is crucial in preventing stent thrombosis





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**Thank You**



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