Antegrade or Retrograde Approach: Different Outcomes or Not?

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Disclosure

Within the past 12 months, the presenter or their spouse/partner have had a financial interest/arrangement or affiliation with the organizations listed below.

Physician Name	Company/Relationship	
Etsuo Tsuchikane, MD, PhD	Abbott Vascular, Japan	Consultant
	Boston Scientific, Japan	Consultant
	Asahi Intecc, Japan	Consultant

Antegrade or Retrograde?
in terms of procedural and follow-up outcomes

- Japanese Registry data
- Myocardial injury
- Subintimal tracking

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Japanese Multicenter Registry Data of Revascularization for CTO:

Analysis of Procedure Outcome on Basis of Each Procedure

(ACC 2014)

Enrollment

Retrograde Summit

Registered Hospitals (in order with entry number)

Sakurabashi Watanabe Hospital	103	Kushiro City General Hospital	27
Saiseikai Yokoham		pital	27
Toyohashi Heart C			27
Sapporo Cardio Va			25
Saitama Cardiovas			24
Takase Clinic		er	23
Saitama Sekishinka		ospital	22
The Cardiovascula			22
Higashi Takarazuk			21
Shinkoga Hospital		spiratory Center	20
Sanda City Hospita			18
Seirei Hamamatsu			16
Nagoya Heart Cen		er	16
Edogawa Hospital	41	Shizuoka General Hospital	15
Nagoya Tokushukai Hospital	41	NTT East Sapporo Hospital	13
Hokkaido Social Insurance Hospital	41	Osaka Saiseikai Izuo Hospital	13
Shiga Medical Center for Adults	35	Tokushima Red Cross Hospital	13
Hoshi General Hospital	33	Iwate Prefectural Central Hospital	9
Kakogawa East City Hospital	30	Hokusetsu General Hospital	8
Hokko Memorial Hospital	30	Toho University Omori Medical Center	3
Kyoto Katsura Hospital	29	Osaki Citizen Hospital	2
Kusatsu Heart Center	29	Other	1

Jan 2012 – Dec 2012

The number of registry : 1553

Registered Hospital : 44

Category for analysis group

Antegrade (n=1,063)	Retrograde (n=202)	Combined (n=288)
✓ Angetrade approach alone (1063)	✓ Retrograde approach alone (202)	✓ Switched to retrograde immediately after antegrade attempt (227*) ✓ Finally switched to antegrade after retrograde attempt (58*)

**No detail information in 3 cases*

Patient characteristics (1)

	Antegrade (1063)	Retrograde (202)	Combined (288)	P value
Age, yo	68.1±10.5	66.6±9.8	67.6±9.9	0.1721
Male	81.9%*	89.1%+	81.6%	**0.0411**
Family history of CAD	17.4%	15.7%	16.6%	0.8518
Previous MI	36.0%*	46.4%	44.2%"	**0.0031**
Previous CABG	6.1%*	18.2%	12.0%"	**<0.0001**
Previous PCI	57.3%*	71.9%+	61.7%	**0.0005**
# of vessel disease - 1-vessel - 2-vessel - 3-vessel	 35.2% 39.7% 25.1%	 38.6% 33.0% 28.4%	 34.0% 36.2% 29.8%	0.2565
Hypertension	80.2%	82.1%	78.2%	0.5510
Diabetes	42.0%	46.4%	45.7%	0.3478
Diabetes, type 1	6.0%	7.7%	7.5%	0.5076
Hyperlipidemia	69.4%	74.6%	68.4%	0.2838

*P<0.05 Antegrade vs. Retrograde +P<0.05 Retrograde vs. combined "P<0.05 Antegrade vs. Combined

Lesion characteristics (1)

	Antegrade (1063)	Retrograde (202)	Combined (288)	P value
Re-attempt	6.6%*	33.5%+	14.5%"	**<0.0001**
Previous strategy				
- Antegrade	79.7%	76.1%	85.4%	
- Retrograde	2.9%	3.0%	2.4%	0.6825
- Both	10.1%	16.4%	4.9%	
- NA	7.3%	4.5%	7.3%	
Previous failure reason				
- Failure to cross CTO by GW	80.7%	92.2%	89.7%	
- Failure to cross collateral by GW	1.8%	1.6%	0.0%	0.5698
- Delivery failure of treatment device	7.0%	3.1%	5.1%	
- NA	10.5%	3.1%	5.1%	

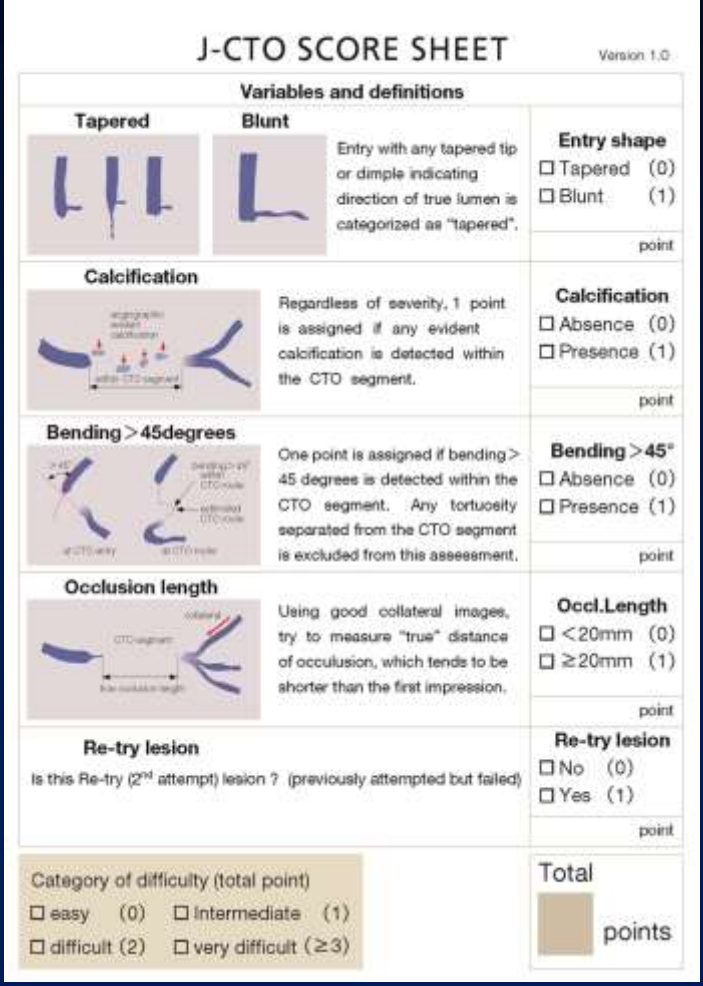
*P<0.05 Antegrade vs. Retrograde +P<0.05 Retrograde vs. combined "P<0.05 Antegrade vs. Combined

Lesion characteristics (2)

	Antegrade (1063)	Retrograde (202)	Combined (288)	P value
Target vessel				
- RCA	39.7%*	67.3%+	57.3%"	<0.0001
- LAD	34.2%*	22.8%	29.2%	
- LCx	26.0%*	9.4%	12.8%"	
- LMT	0.1%	0.5%	0.7%	
Reference diameter	2.9±1.3mm*	3.2±1.5mm	3.1±0.5mm"	0.0010
Occlusion length	22.7±15.1mm*	32.4±19.4mm	32.2±19.1mm"	<0.0001
In-stent occlusion	17.1%*	9.2%	9.9%"	0.0006
Occlusion period				
- ≥ 1 year	5.9%*	16.2%	12.5%"	<0.0001
- < 1 year	9.0%	7.6%	10.3%	
- Unknown	85.1%*	76.1%	77.2%"	
Collateral filling grade				
- CC 0	11.6%*	2.4%+	8.5%	0.0008
- CC 1	58.4%	56.8%	56.0%	
- CC 2	29.9%*	40.8%	35.5%	

*P<0.05 Antegrade vs. Retrograde +P<0.05 Retrograde vs. combined "P<0.05 Antegrade vs. Combined

J-CTO score



J-CTO SCORE SHEET

Version 1.0

Variables and definitions

Tapered / **Blunt**

Entry with any tapered tip or dimple indicating direction of true lumen is categorized as "tapered".

Entry shape
☐ Tapered (0)
☐ Blunt (1)
point

Calcification

Regardless of severity, 1 point is assigned if any evident calcification is detected within the CTO segment.

Calcification
☐ Absence (0)
☐ Presence (1)
point

Bending >45degrees

One point is assigned if bending > 45 degrees is detected within the CTO segment. Any tortuosity separated from the CTO segment is excluded from this assessment.

Bending >45°
☐ Absence (0)
☐ Presence (1)
point

Occlusion length

Using good collateral images, try to measure "true" distance of occulusion, which tends to be shorter than the first impression.

Occl.Length
☐ <20mm (0)
☐ ≥20mm (1)
point

Re-try lesion

Is this Re-try (2nd attempt) lesion ? (previously attempted but failed)

Re-try lesion
☐ No (0)
☐ Yes (1)
point

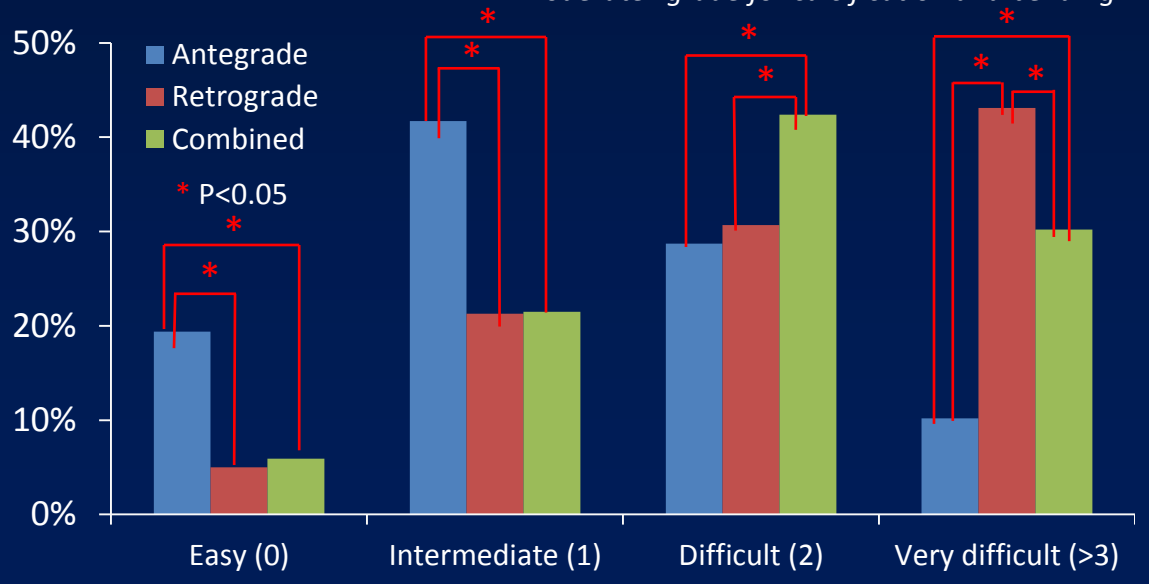
Category of difficulty (total point)
☐ easy (0) ☐ Intermediate (1)
☐ difficult (2) ☐ very difficult (≥3)

Total ____ points

** Morino et al. JACC Interv 2011;4:231-211)*

	Antegrade (1063)	Retrograde (202)	Combined (288)
Blunt tip/none or unclear tip	46.5%	71.9%	67.7%
Calcification*	28.3%	42.3%	47.4%
Bending*	5.7%	14.4%	14.8%
Occlusion length>20mm	54.6%	77.7%	76.6%
Re-try lesion	6.6%	33.5%	14.5%

**Score was counted based on judgment more than "moderate" grade for calcification and bending*

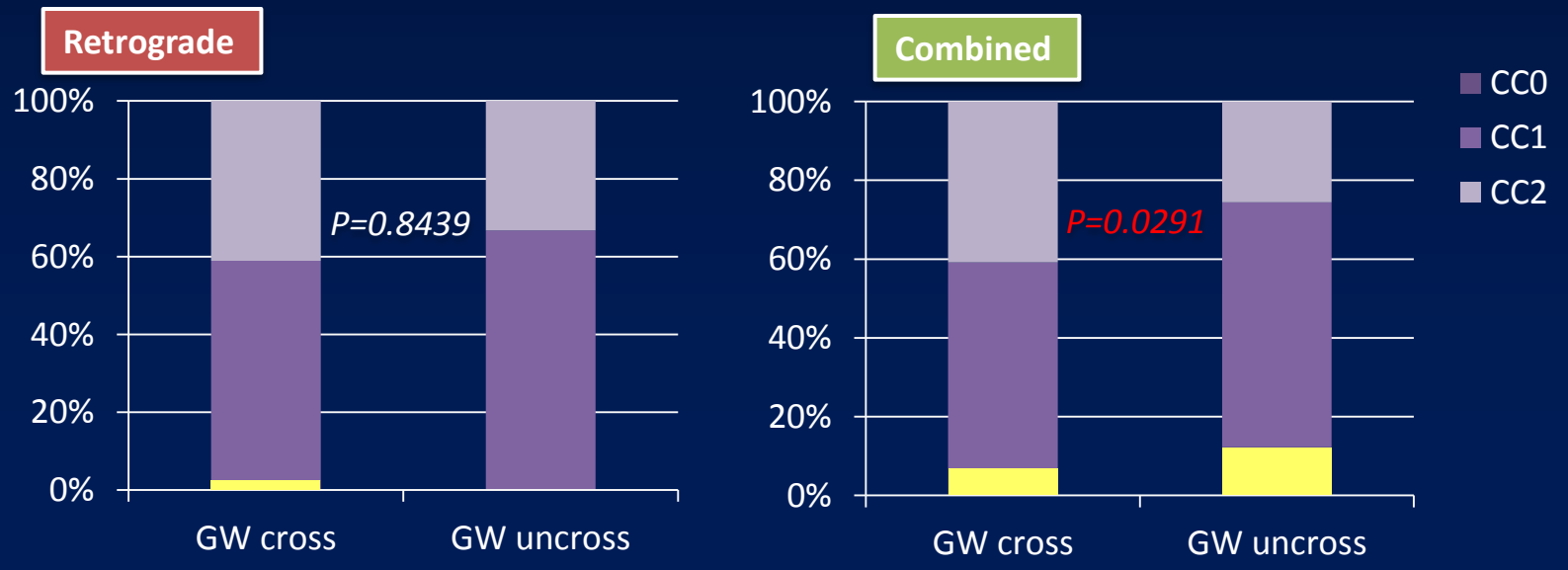


Collateral channel tracking

In retrograde (n=202) and combined cases (n=288)

	Retro (202)	Combined (288)	P value
Successful collateral channel crossing by guidewire	96.5% (195)	64.2% (185)	<0.0001
Number of used GW	1.7±1.3	1.8±1.3	0.4665
Use of Corsair after collateral crossing by guidewire	94.7%	89.4%	0.0523

Successful GW crossing by collateral filling grade



Procedure outcome

	Antegrade (1063)	Retrograde (202)	Combined (288)	P value
Successful CTO crossing by guidewire	91.8% (976)	92.6% (187)+	79.2% (228)"	<0.0001
Number of guidewire used for CTO approach	2.5±1.5*	4.7±2.9+	5.3±2.6"	<0.0001
Number of stent	1.7±0.8*	2.4±0.9	2.3±1.0"	<0.0001
Procedure success	90.8% (965)	92.1% (186)+	76.7% (221)"	<0.0001
Procedure time, min	114.4±62.3*	191.7±94.3	207.8±88.1"	<0.0001
Contrast dose, ml	209.4±94.8*	234.2±101.1+	292.6±126.2"	<0.0001
Fluoroscopy time, min	49.5±30.9*	88.3±46.8+	98.1±46.3"	<0.0001
Air Kerma, mGy	3,987.5±3,144.7*	5,753.2±3,788.4	6,389.4±4,772.4"	<0.0001
MACCE	0.5% (5)	1.0% (2)	1.4% (4)	0.2253

*P<0.05 Antegrade vs. Retrograde +P<0.05 Retrograde vs. combined "P<0.05 Antegrade vs. Combined

MACCE

	Antegrade (1063)	Retrograde (202)	Combined (288)	P value
MACCE	**0.5% (5)**	**1.0%(2)**	**1.4%(4)**	**0.2253**
- Cardiac death	0.3% (3)	-	-	
- Non cardiac death	0.1% (1)	-	0.4%(1)	
- MI	-	0.5%(1)	1.0%(3)	
- Stroke / non-bleeding	0.1% (1)	0.5%(1)		

Other procedural complications

	Antegrade (1063)	Retrograde (202)	Combined (288)	P value
Adverse Event	**0.9% (9)**	**2.0% (4)**	**3.8% (11) "**	**0.0012**
- Cardiac tamponade	0.2% (2)	1.0% (2)	1.0% (3)	
- Transient Cerebral Ischemic Attack	0.1% (1)	-		
- Contrast induced nephropathy	0.1% (1)	-	0.3% (1)	
- Coronary perforation	0.5% (5)	0.5% (1)	2.1% (6)	
- Guidewire fracture	-	0.5% (1)	0.3% (1)	

"P<0.05 Antegrade vs. Combined

Retrograde approach relevant complications

Including minor events

	Retrograde (202)	Combined (288)	P value
Retrograde approach relevant	**7.4% (15)**	**14.9% (43)**	**0.0114**
- Channel injury	6.4% (13)	14.3% (41)	
➢ Additional treatment required	3.0% (6)	4.9% (14)	
➢ Cardiac tamponade	0.0% (0)	0.7% (2)	
- Donor artery trouble	-	0.3% (1)	
- Other events	1.0% (2)	0.3% (1)	

Retrograde Summit

Sub Analysis from 2012-2013 Registry

Impact of Operator Experience on Procedural Results

Definition of Analysis Group

- **Higher volume center (HC) : 18 center**

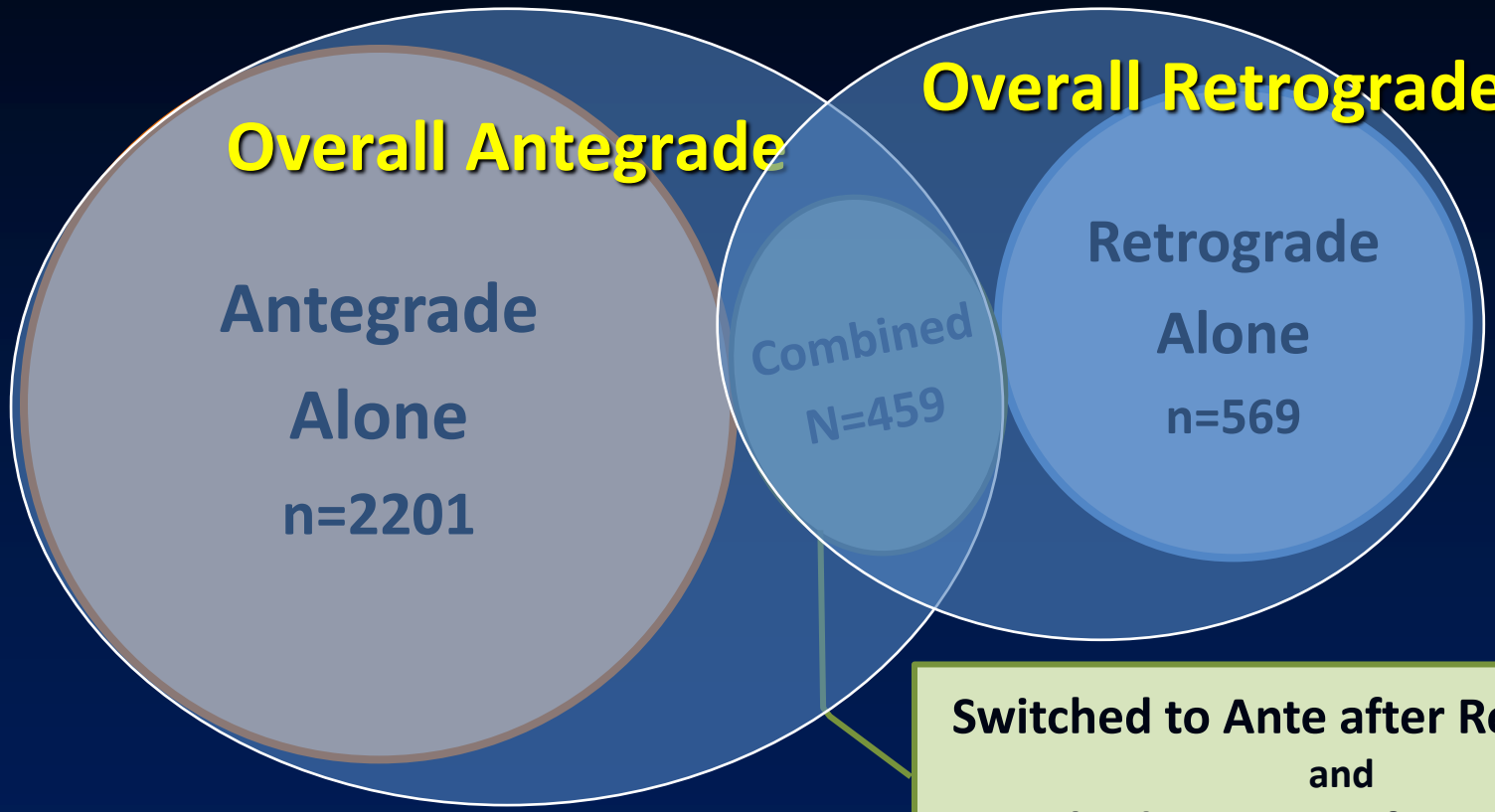
  There is one or more operator with estimated CTO-PCI volume ≥ 50 per year* (* including proctor cases)

- **Lower volume center (LC) : 38 center**

  There is not such higher volume operator

	HC (18)	LC (38)
Average of enrolled pts number per center	52.4±27.5	23.0±12.3

Enrollment (Jan 2012 – Dec 2013)



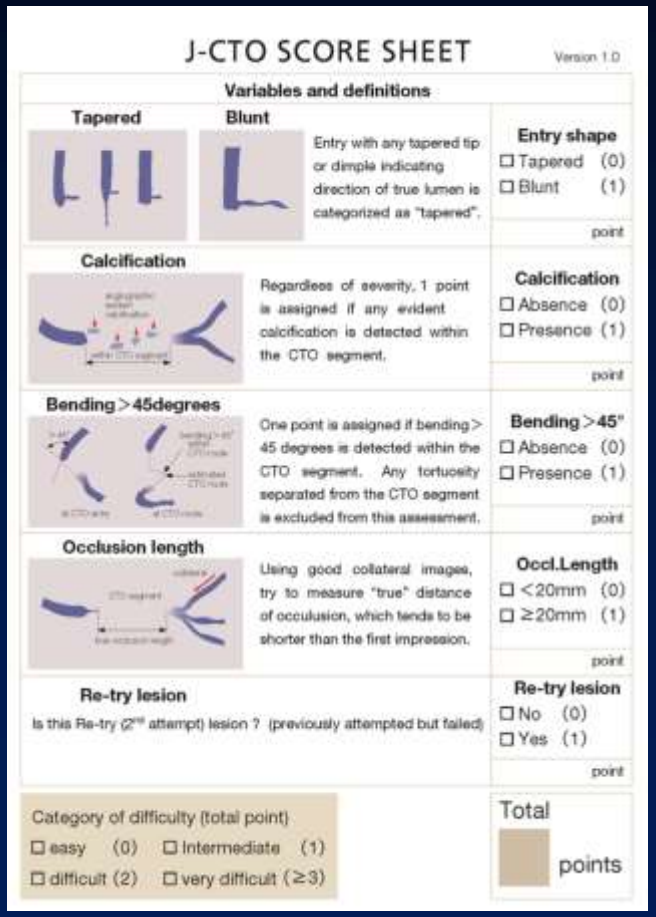
Switched to Ante after Retro failure
and
Switched to Retro after Ante failure

Total 3229 cases were enrolled from 56 of registered hospital

Lesion Characteristics (1)

	HC (1782)	LC (1447)	P value
Target vessel - RCA - LAD - LCx - LMT	 47.6% (848) 31.5% (562) 20.6% (367) 0.28% (5)	 48.2% (697) 29.9% (433) 21.8% (315) 0.14% (2)	0.5726
Reference diameter	**2.9±0.5**	**3.0±0.6**	**0.0030**
Occlusion length	24.9±15.6	24.3±18.1	0.3954
In-stent occlusion	14.4% (257)	14.4% (209)	0.9861
Occlusion period **- > 1 year** **- < 1 year** **- Unknown**	 **6.96% (124)** **5.89% (105)** **87.15% (1553)**	 **11.13% (161)** **9.74% (141)** **79.13% (1145)**	**<0.0001**

Lesion Characteristics: J-CTO score



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Occlusion length

Using good collateral images, try to measure "true" distance of occulusion, which tends to be shorter than the first impression.

Occl.Length
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point

Re-try lesion

Is this Re-try (2nd attempt) lesion ? (previously attempted but failed)

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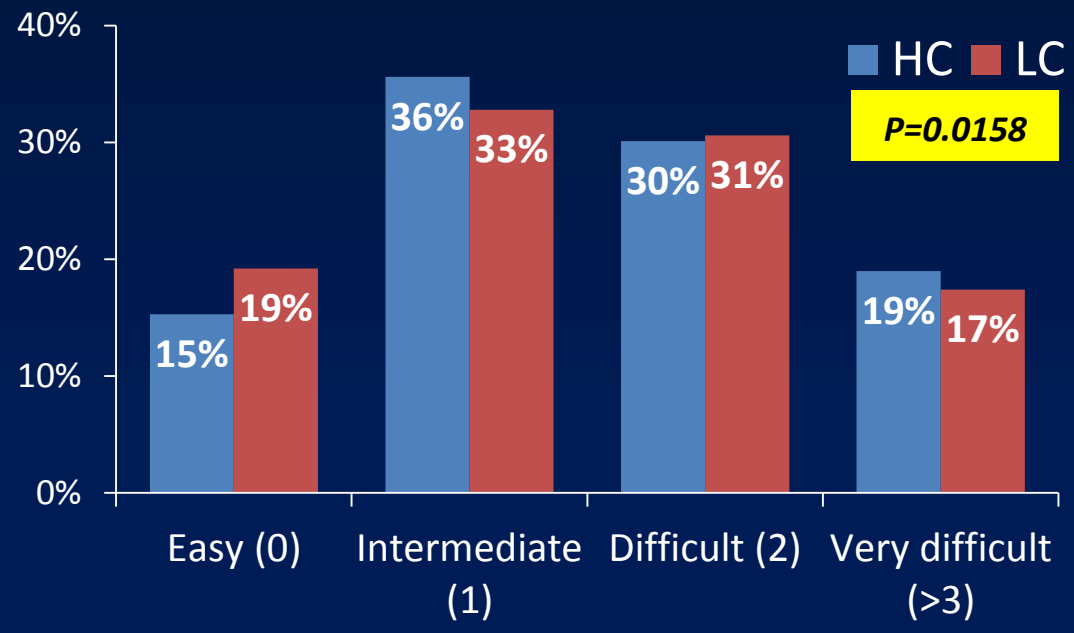
☐ No (0)
☐ Yes (1)
point

Category of difficulty (total point)
☐ easy (0) ☐ Intermediate (1)
☐ difficult (2) ☐ very difficult (≥3)

Total ____ points

J-CTO score Average

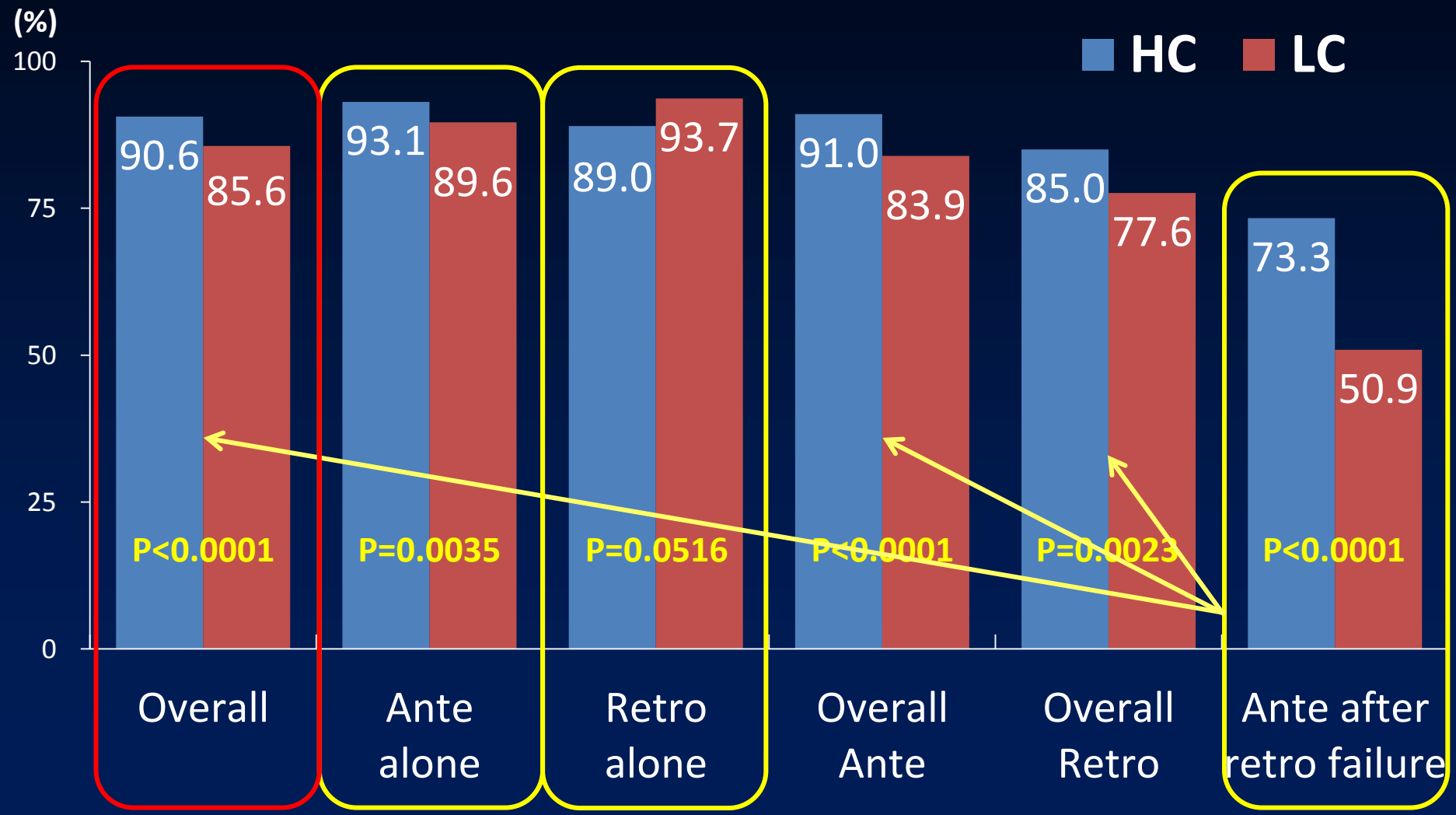
HC	LC	P value
1.58±1.07	1.50±1.06	0.03



Procedure Outcome

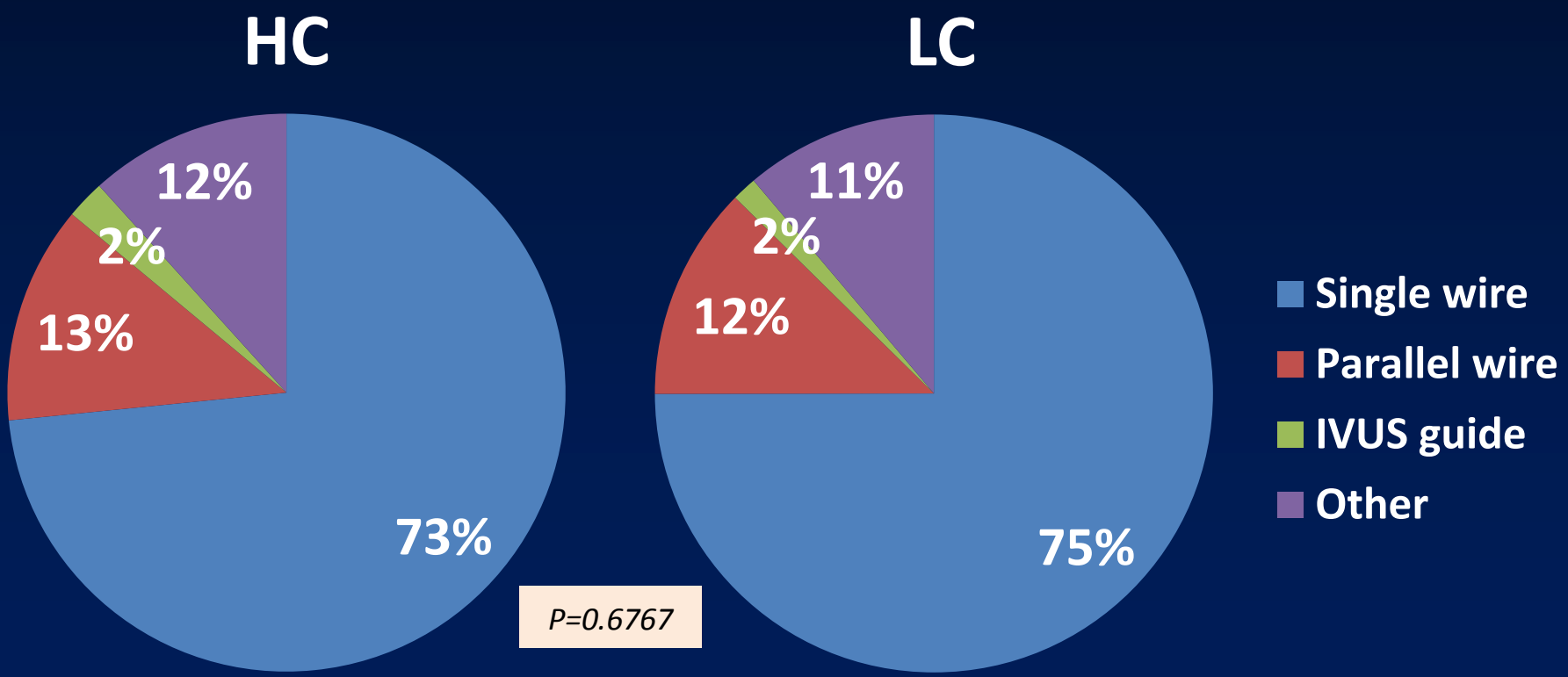
	HC (1782)	LC (1447)	P value
Stent deployment	96.78% (1475)	96.94% (1141)	0.8172
Number of stent	1.84±0.94	1.85±0.92	0.7634
Total stent length, mm	53.50±25.84	53.52±27.25	0.9803
Use of drug-eluting stent	98.80% (1484)	98.01% (1130)	0.0990
Number of guidewire used for CTO approach	3.4±2.7	3.3±21	0.1326
Contrast dose, ml	**235.93±107.57**	**216.83±101.46**	**< 0.0001**
Procedure time, min	**137.88±83.86**	**160.86±86.93**	**< 0.0001**
Fluoroscopy time, min	**63.42±43.30**	**72.81±47.55**	**< 0.0001**
Air Kerma, mGy	4719.29±3865.73	4963.80±3766.40	0.13

Procedure Success Rate
HC vs. LC



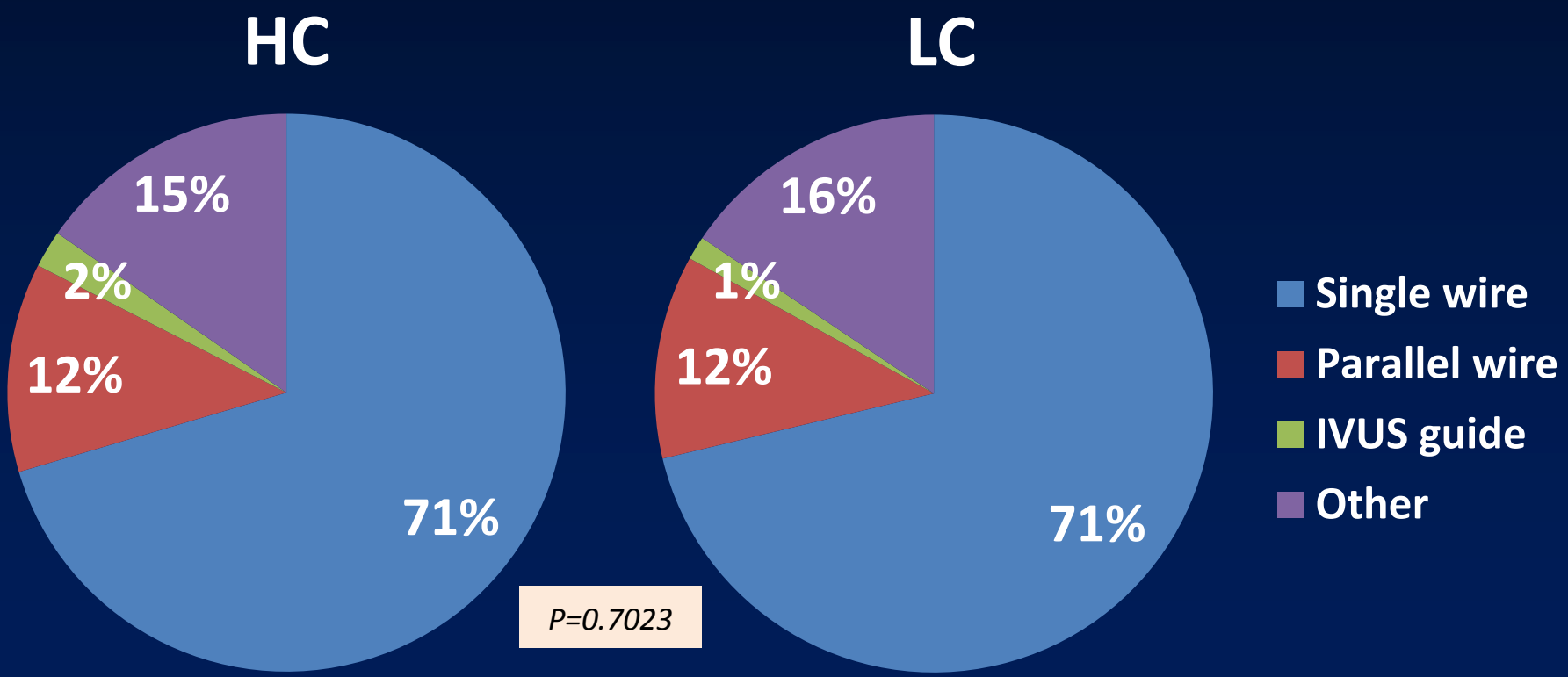
GW Technique for Successful CTO body Crossing

Primary Antegrade approach (2508)	HC (1397)	LC (1111)	P value
Successful CTO body crossing by GW	92.3% (1290)	87.8% (975)	0.0001



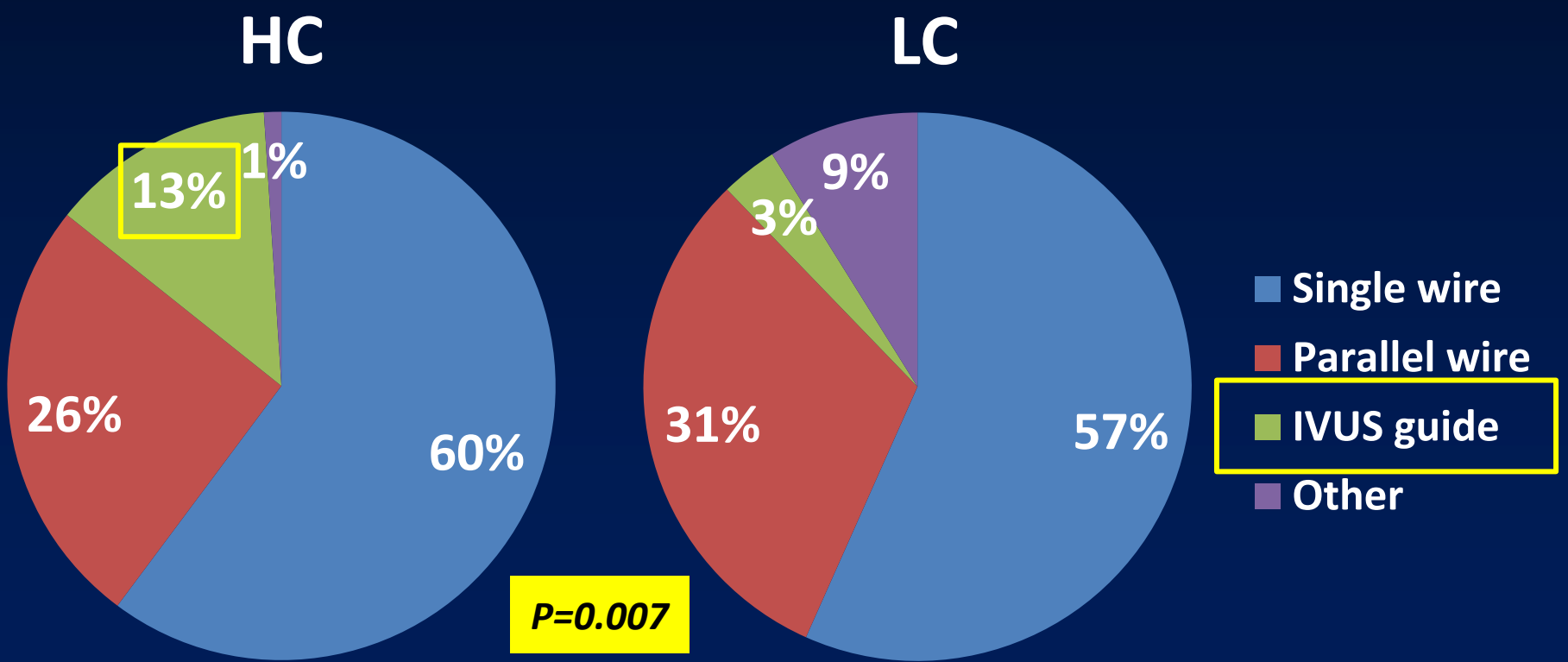
GW Technique for Successful CTO body Crossing

Overall Antegrade approach (2660)	HC (1465)	LC (1195)	P value
Successful CTO body crossing by GW	91.8% (1343)	85.9% (1026)	<0.0001



GW Technique for Successful CTO body Crossing

Antegrade approach after retrograde approach failure (296)	HC (131)	LC (165)	P value
Successful CTO body crossing by GW	74.8% (98)	54.6% (90)	0.0003



Antegrade or Retrograde?
in terms of procedural and follow-up outcomes

- Japanese Registry data
- Myocardial injury
- Subintimal tracking

Low incidence of cardiac biomarker elevation following PCI of chronic total coronary occlusions

Philipp Bahrma

Clinic of Internal

D, FACC, FESC

Table 2. Angiographic characteristics of study groups

Characteristic	Group with CTOs (n=201)	Group with single non-occlusive lesions (n=111)	p Value for difference
Target vessel of the lesion			0.134
Left anterior descending artery, %	35	27	
Left circumflex artery, %	8	14	
Right coronary artery, %	57	59	
No. of stents	1.72±.91	1.13±.52	<0.001
Stent length, mm	41±21	16±5	<0.001
Final balloon diameter, mm	2.97±.40	3.14±.39	<0.001
Lesion length, mm	31±21	13±4	<0.001
Duration of PCI, min	116±34	77±26	<0.001

CTO = chronic total coronary occlusion. Values are mean values ±SD or %.

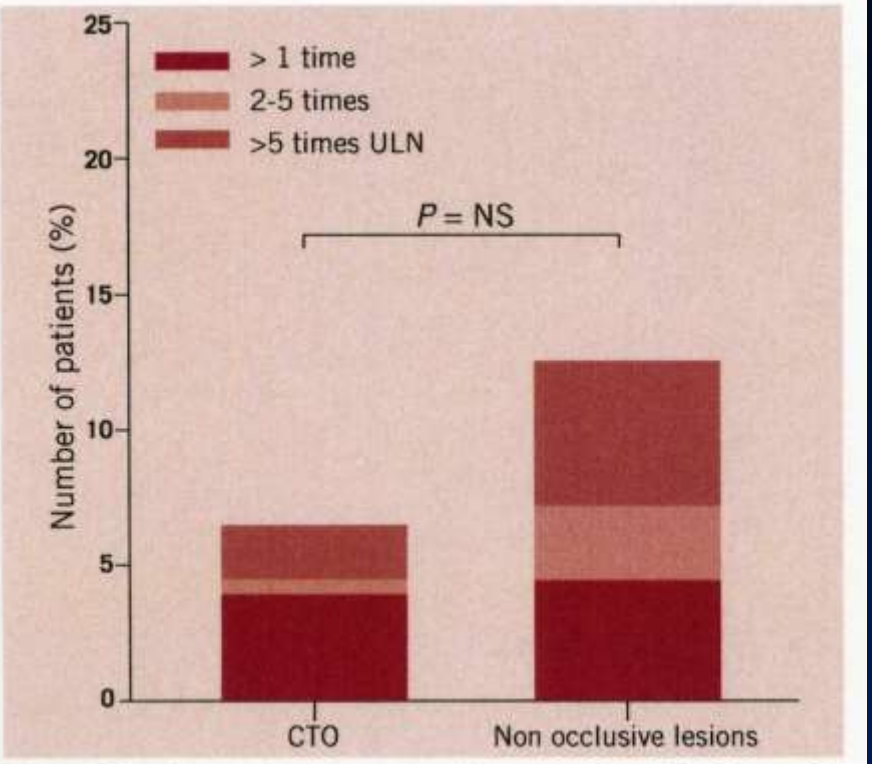


Figure 1. Incidence of postprocedural increase of creatine kinase-MB fraction >1, 2 to 5, and >5 times above upper normal limit (P=NS).

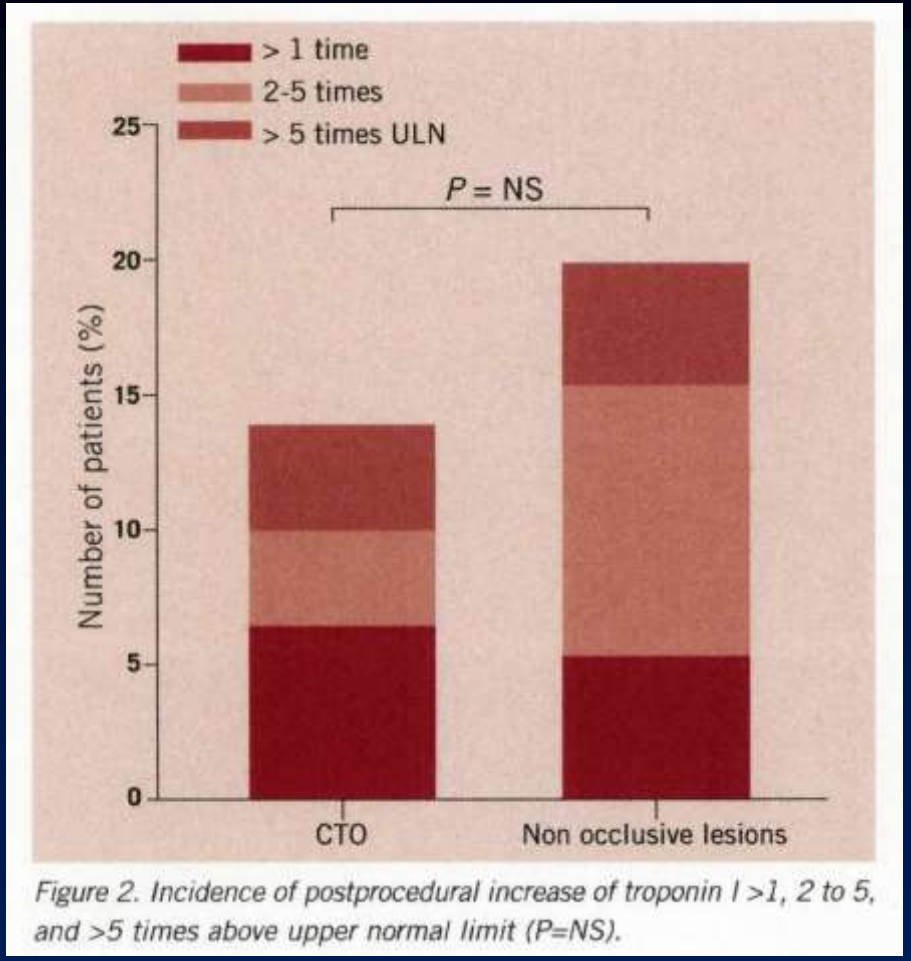


Figure 2. Incidence of postprocedural increase of troponin I >1, 2 to 5, and >5 times above upper normal limit (P=NS).

- CK-MB elevation was observed in only 6% of CTO.
- No difference in CK-MB/cTNI elevation compared to DES in SVD.

Periprocedural
total coronary
retrograde app

Gerald S. Werner*, MD, F

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Table 1. Clinical characteristics in patients with antegrade and retrograde approach in CTO PCI.

	Antegrade (n=386)	Retrograde (n=106)	p
Age, years	64.9±10.9	62.2±11.1	0.02
Male gender [%]	84	86	0.83
CCS (1/2/3/4) [%]	7/67/22/4	11/58/28/3	0.29
NYHA (0/I/II/III/IV) [%]	84/1/10/5/0	84/1/9/6/0	0.98
Family history [%]	23.5	20.0	0.65
Hypertension [%]	77.6	85.6	0.09
Hypercholesterolaemia [%]	75.3	72.2	0.54
Diabetes [%]	27.0	25.6	0.26
Body mass index [kg/m²]	28.2±4.3	28.7±4.0	0.23
GFR [ml/min]	70.4±20.7	70.0±24.9	0.89
GFR <60 ml/min [%]	28	27	0.84
History of smoking [%]	44.1	51.1	0.42
Previous MI [%]	33.3	42.2	0.21
Previous CABG [%]	12.4	13.3	0.29
Previous PCI [%]	54.5	63.3	0.21
Normal LV ejection fraction [%]	73.9	75.6	0.94
Regional function (normal, hypokinetic, akinetic) [%]	53/30/17	52/37/11	0.61
Number of vessels diseased			0.17
One-vessel disease [%]	16.9	17.0	
Two-vessel disease [%]	29.4	27.4	
Three-vessel disease [%]	53.7	55.6	
Duration of CTO [months]	24 [10-60]	60 [24-129]	<0.001
Previous PCI attempts [%]	33.3	66.7	<0.001

Table 2. Angiographical characteristics of patients with antegrade and retrograde approach for CTO.

	Antegrade (n=386)	Retrograde (n=106)	*p*
Target vessel of the lesion			<0.001
Left anterior descending artery [%]	23.3	15.1	
Left circumflex artery [%]	18.7	4.7	
Right coronary artery [%]	58.0	79.2	
In-stent occlusion [%]	4.9	11.1	0.02
Duration of procedure [min]	111 [84-140]	166 [134-214]	<0.001
Total fluoroscopic time [min]	35 [24-52]	72 [54-91]	<0.001
Contrast volume [ml]	275 [210-360]	354 [272-448]	<0.001
Number of guidewires used	3.1±1.6	5.9±1.9	<0.001
Procedural success [%]	75.6	63.2	0.011
Eventual success in lesion [%] *	88.0	79.2	0.16
Reference vessel diameter [mm]	2.81±0.44	2.95±0.36	0.005
Lesion length [mm]	22.6±13.1	37.7±19.7	<0.001
No. of stents ¶	2.25±1.07	2.91±1.29	<0.001
Stent length [mm] ¶	48.2±30.9	62.9±39.3	0.26

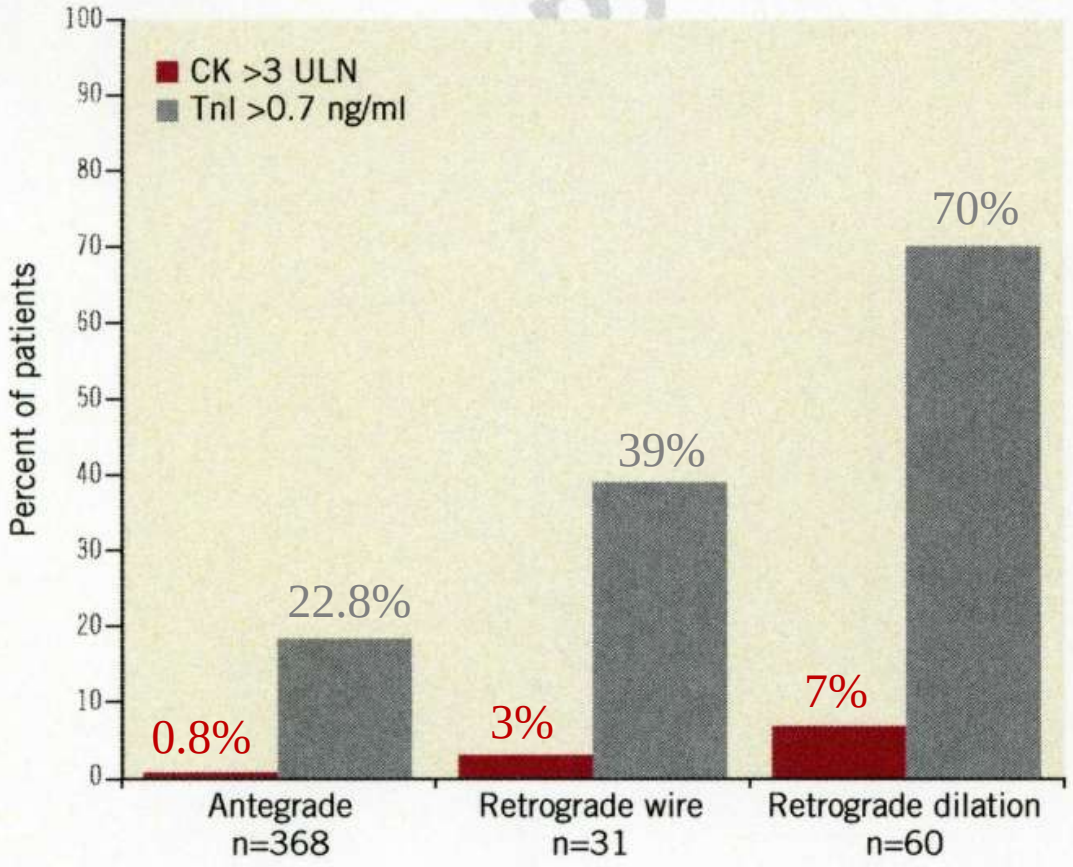

Figure 1. *The relation of the applied technique and the incidence of periprocedural infarctions (without development of new Q-waves) defined as a CK increase >3 times ULN within 24 hours of the PCI of a CTO, and the incidence of periprocedural troponin increase above 0.7 ng/ml within 24 hours. Only retrograde procedures involving the transseptal pathway are shown.*

Periprocedural Myocardial Injury in Chronic Total Occlusion Percutaneous Interventions

A Systematic Cardiac Biomarker Evaluation Study

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Objectives This study sought to evaluate the incidence, correlates, and clinical implications of periprocedural myocardial injury (PMI) during percutaneous coronary intervention (PCI) of chronic total occlusions (CTO).

Background The risk of PMI during CTO PCI may be underestimated because systematic cardiac biomarker measurement was not performed in published studies.

Methods We retrospectively examined PMI among 325 consecutive CTO PCI performed at our institution between 2005 and 2012. Creatine kinase-myocardial band fraction and troponin were measured before PCI and 8 to 12 h and 18 to 24 h after PCI in all patients. PMI was defined as creatine kinase-myocardial band increase $\geq 3\times$ the upper limit of normal. Major adverse cardiac events during mid-term follow-up were evaluated.

Results Mean age was 64 ± 8 years. The retrograde approach was used in 26.8% of all procedures. The technical and procedural success was 77.8% and 76.6%, respectively. PMI occurred in 28 patients (8.6%, 95% confidence intervals: 5.8% to 12.2%), with symptomatic ischemia in 7 of those patients. The incidence of PMI was higher in patients treated with the retrograde than the antegrade approach (13.8% vs. 6.7%, $p = 0.04$). During a median follow-up of 2.3 years, compared with patients without PMI, those with PMI had a higher incidence of major adverse cardiac events (hazard ratio [HR]: 2.25, $p = 0.006$). Patients with only asymptomatic PMI also had a higher incidence of major adverse cardiac events on follow-up (HR: 2.26, $p = 0.013$).

Conclusions Systematic measurement of cardiac biomarkers post–CTO PCI demonstrates that PMI occurs in 8.6% of patients, is more common with the retrograde approach, and is associated with worse subsequent clinical outcomes during mid-term follow-up. (J Am Coll Cardiol Intv 2014;7:47–54)

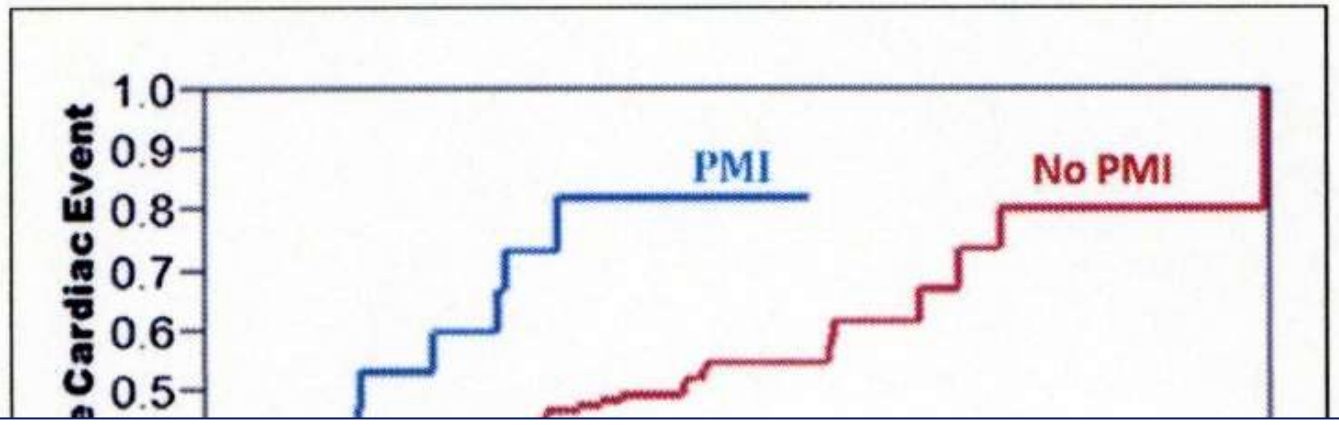
Table 1. Clinical and Angiographic Characteristics and Outcomes of the Study Patients, Classified According to Whether They Underwent CTO PCI Using the Antegrade or the Retrograde Approach

	All Patients (N = 325)	Antegrade (n = 238)	Retrograde (n = 87)	p Value
Age, yrs	64 ± 8.4	64 ± 8.8	64 ± 7.4	0.704
Men	98.7	98.7	98.8	0.935
Hypertension	90.0	89.5	91.9	0.501
Hyperlipidemia	89.0	87.8	91.9	0.278
Diabetes	47.0	48.2	43.7	0.447
Heart failure	38.4	39.5	35.6	0.527
History of MI	47.3	45.4	53.9	0.231
History of CABG	26.0	20.7	40.2	0.001
History of stroke	4.3	3.8	5.7	0.452
Prior PCI	36.4	40.5	25.3	0.011
Initial presentation with ACS	20.9	23.5	13.8	0.048
CTO target vessel				0.001
RCA	56.2	47.0	79.1	
LCX	20.9	25.6	9.3	
LAD	21.6	26.1	10.5	
LMCA/graft	1.3	1.4	1.3	
Number of stents implanted	2 (0, 3)	2 (1, 3)	3 (0, 4)	0.387
Procedure time, min	124 (88–177)	107.5 (84.3–141.7)	192 (151–238)	0.001
Fluoroscopy time, min	34.7 (21.6–52.7)	28.6 (18.5–40.3)	55.2 (44.6–71.7)	0.001
Air kerma radiation exposure, Gy	4.4 (3.0–5.9)	3.4 (2.4–5.0)	5.7 (4.5–7.3)	0.001
Contrast volume, ml	338 (250–430)	310 (230–400)	400 (300–500)	0.001
Post-PCI CK-MB increase ≥3× ULN	8.6	6.7	13.8	0.044
Post-PCI Troponin ≥3× ULN	60.6	51.7	85.1	<0.0001
Post-PCI Troponin ≥10× ULN	43.1	33.2	70.1	<0.0001
Post-PCI Troponin ≥20× ULN	31.4	24.8	49.4	<0.0001
Technical success	77.8	80.7	70.1	0.047
Procedural success	76.6	80.3	66.7	0.014

Table 4. Clinical and Angiographic Characteristics and Outcomes of the Study Patients, Classified According to Whether They Had PMI

	All Patients (N = 325)	PMI (n = 28)	No PMI (n = 297)	p Value
Age, yrs	64 ± 8.4	63 ± 5.6	64 ± 8.7	0.281
Men	98.7	100.0	98.6	0.394
Hypertension	90.0	100.0	89.2	0.014
Hyperlipidemia	89.0	92.9	88.6	0.464
Diabetes	47.0	32.1	48.5	0.094
Heart failure	38.4	35.7	38.7	0.754
History of MI	47.3	50.0	47.1	0.772
History of CABG	26.0	46.4	24.0	0.014
History of stroke	4.3	3.6	4.4	0.837
Prior PCI	36.4	46.4	35.5	0.256
Retrograde approach	26.8	43.9	25.3	0.044
CTO target vessel				0.393
LMCA/graft	1.3	0	1.5	
Technical success	77.8	67.9	78.8	0.201
Procedural success	76.6	67.9	77.4	0.268
Number of stents implanted	2 (0–3)	3 (0–4)	2 (0–3)	0.778
Procedure time, min	124 (88–177)	175 (147–241)	120 (88–174)	<0.0001
Fluoroscopy time, min	34.7 (21.6–52.7)	64.5 (43.5–72.7)	31.9 (21.1–50.0)	<0.0001
Air kerma radiation exposure, Gray	4.4 (3.0–5.9)	5.9 (5.3–7.4)	4.2 (2.8–5.6)	0.012
Contrast volume, ml	338 (250–430)	450 (375–545)	325 (245–415)	<0.0001

2 variables associated with PMI;
DM (OR: 0.45) and prior CABG (OR: 3.0), but not Retrograde approach!



1) PMI cause worse long-term outcomes.
2) PMI is more common with retrograde approach.

Retrograde approach is not directly related to worse long-term outcomes.

Figure 3. Kaplan-Meier Curves of the Incidence of MACE in Patients With and Without PMI After CTO PCI

The incidence of major adverse cardiac events (MACE) during a median of 2.3 years (interquartile range: 0.8 to 4.6 years) was higher among patients who had PMI during CTO PCI than in those who did not have PMI (hazard ratio: 2.25; 95% confidence interval: 1.28 to 3.70, p = 0.006). Abbreviations as in Figure 1.

Antegrade or Retrograde?
in terms of procedural and follow-up outcomes

- Japanese Registry data
- Myocardial injury
- Subintimal tracking

Our Questions
About the Subintimal Tracking

1. How often in the contemporary CTO-PCI?

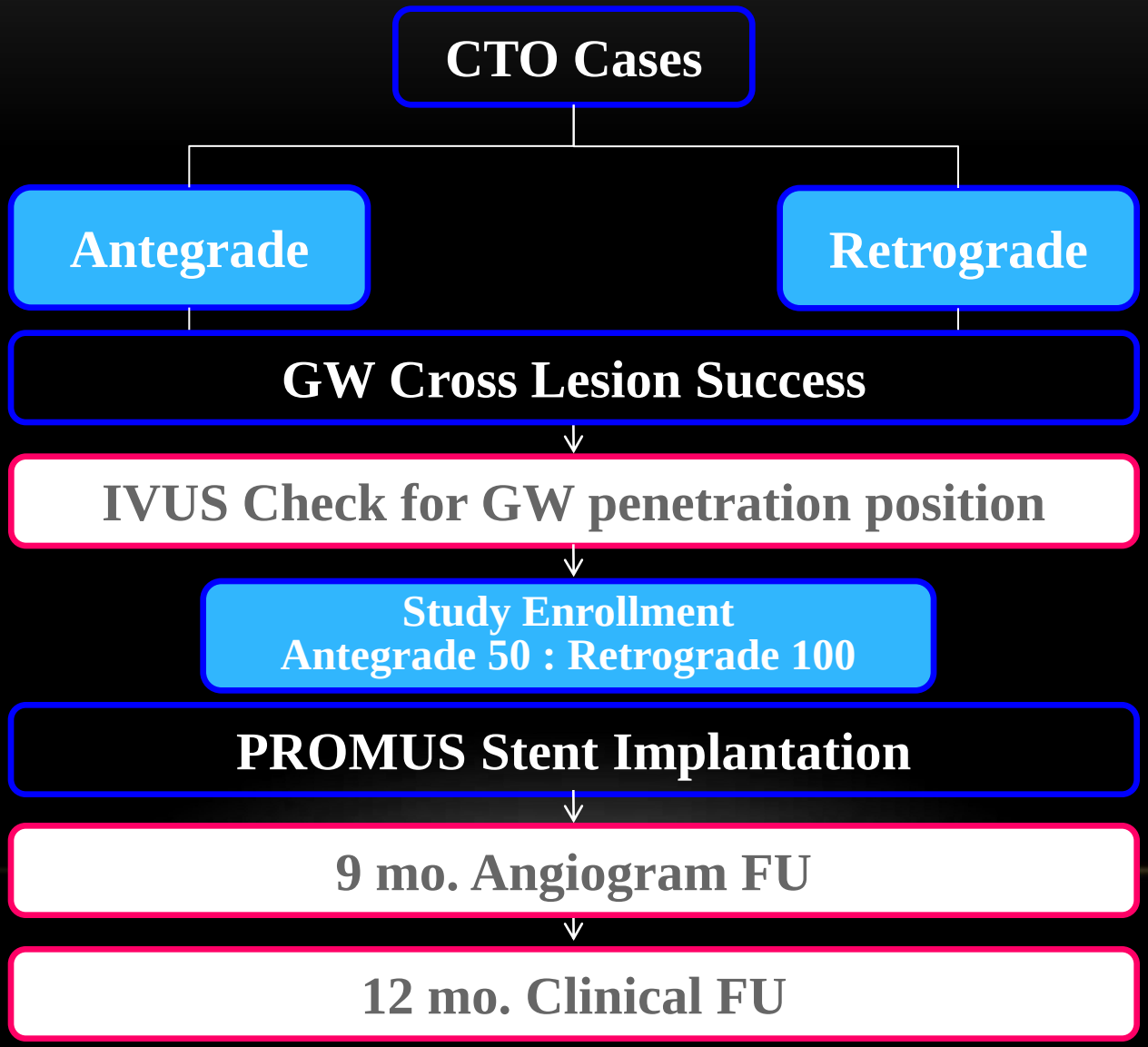
2. Any effect of localized subintimal tracking on long-term outcomes after DES?

J-PROCTOR REGISTRY

PROMUS STENT TREATMENT OF
CHRONIC TOTAL OCCLUSIONS
USING TWO DIFFERENT RECANALIZATION
TECHNIQUES IN JAPAN

(*EuroIntervention 2014;10:681*)

Study Design
Flow Chart



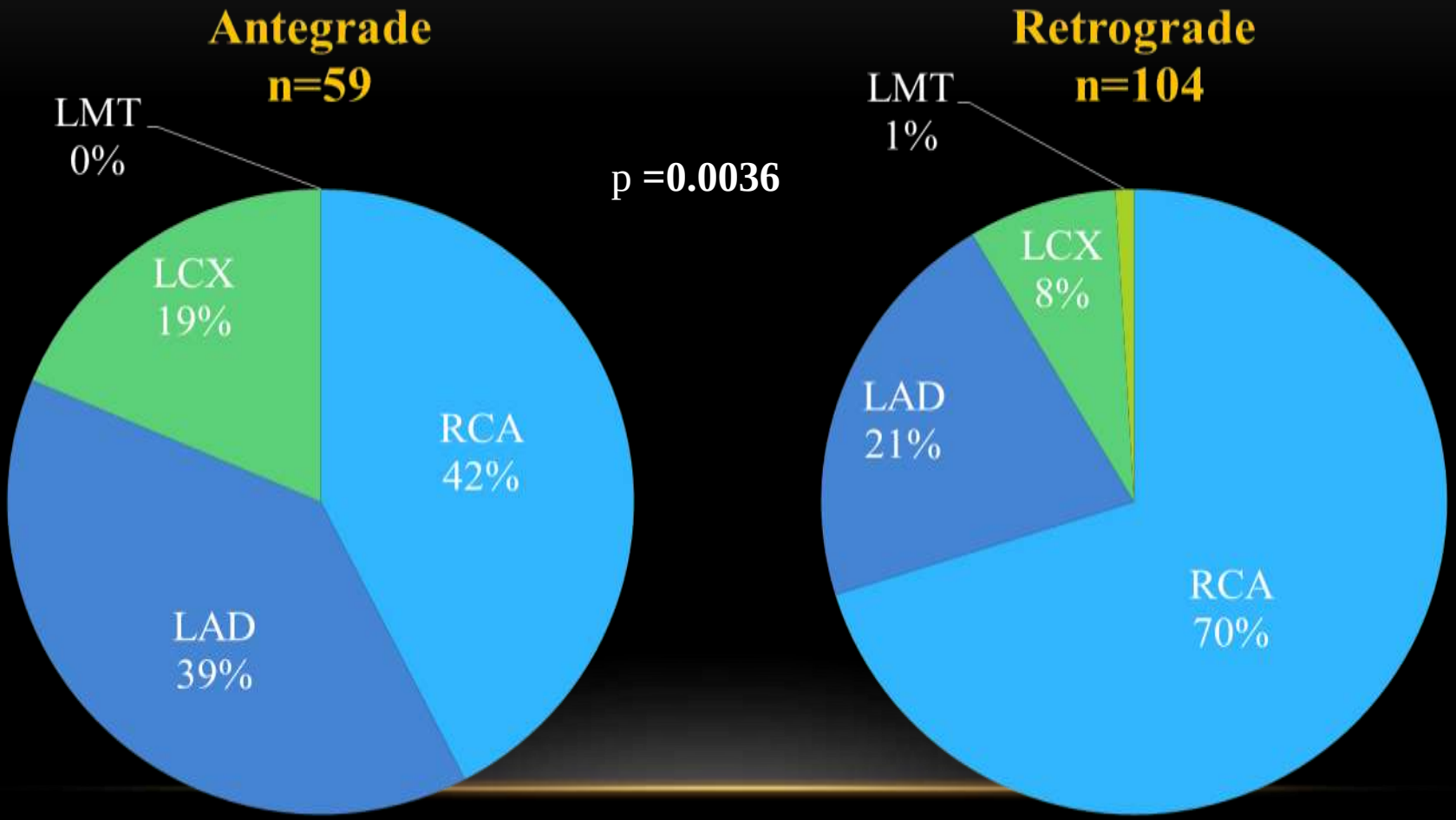
Baseline Patient Characteristics

	Ante 59	Retro 104	p value
Male	86.4%	89.4%	0.62
Age (years)	65.4 ±10.4	65.6 ±10.6	0.95
Previous MI	30.5%	44.2%	0.10
Previous CABG	6.8%	12.5%	0.30
Hypertension	64.4%	69.2%	0.60
Diabetes mellitus	37.3%	33.7%	0.73
Hyperlipidemia	62.7%	76.9%	0.07
Smoking	22.0%	13.5%	0.19
Average diseased vessel	1.9 ±0.8	1.8 ±0.8	0.70
Multi vessel disease	61.0%	56.7%	0.62

Lesion Characteristics

	Ante 59	Retro 104	p value
Calcification	67.8%	69.2%	0.86
Proximal tortuosity	33.9%	45.2%	0.19
Bending (>45)	3.4%	6.7%	0.49
Bifurcation	33.9%	29.8%	0.60
Occlusion length, mm	13.7±12.0	22.9±16.7	0.001
Reference diameter, mm	2.72±0.43	2.96±0.43	0.001
Reattempt	5.1%	27.9%	<0.0001
Bridge collateral	47.4%	45.5%	0.87

Target Vessel



PCI Procedure

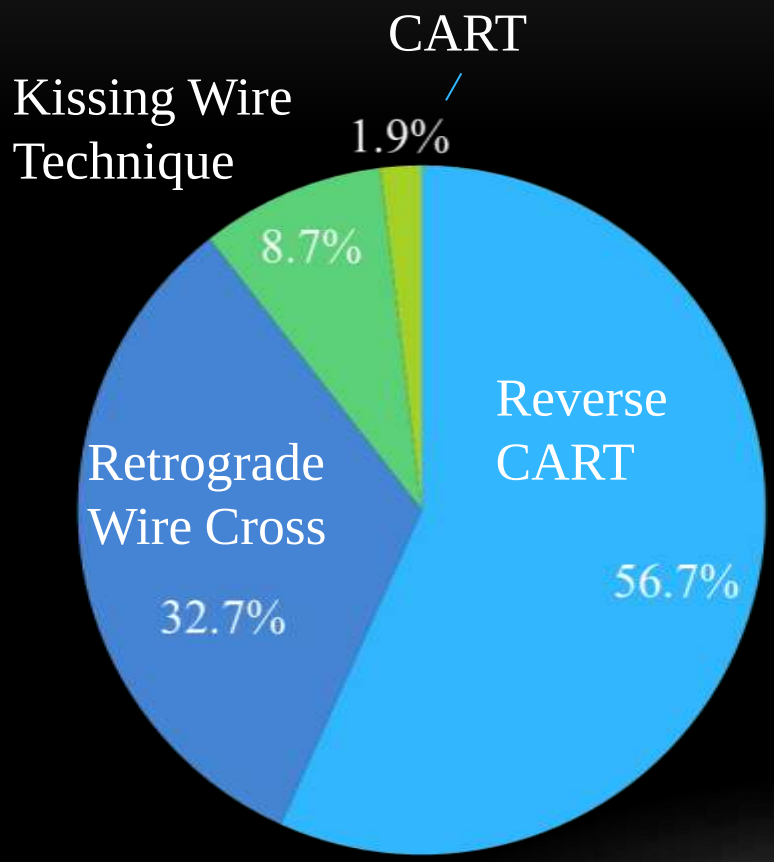
	Ante 59	Retro 104	p value
Number of GW	2.5±1.8	4.7±2.2	0.024
IVUS guided wiring	6.8%	60.6%	<0.0001
Number of stent	1.9±0.9	2.8±1.0	<0.0001
Maximum stent diameter, mm	3.00±0.39	3.13±0.39	0.035
Stent length, mm	41.2±20.6	59.6±23.5	<0.0001
Maximum stent pressure, atm	12.2±3.3	13.9±3.3	0.0020

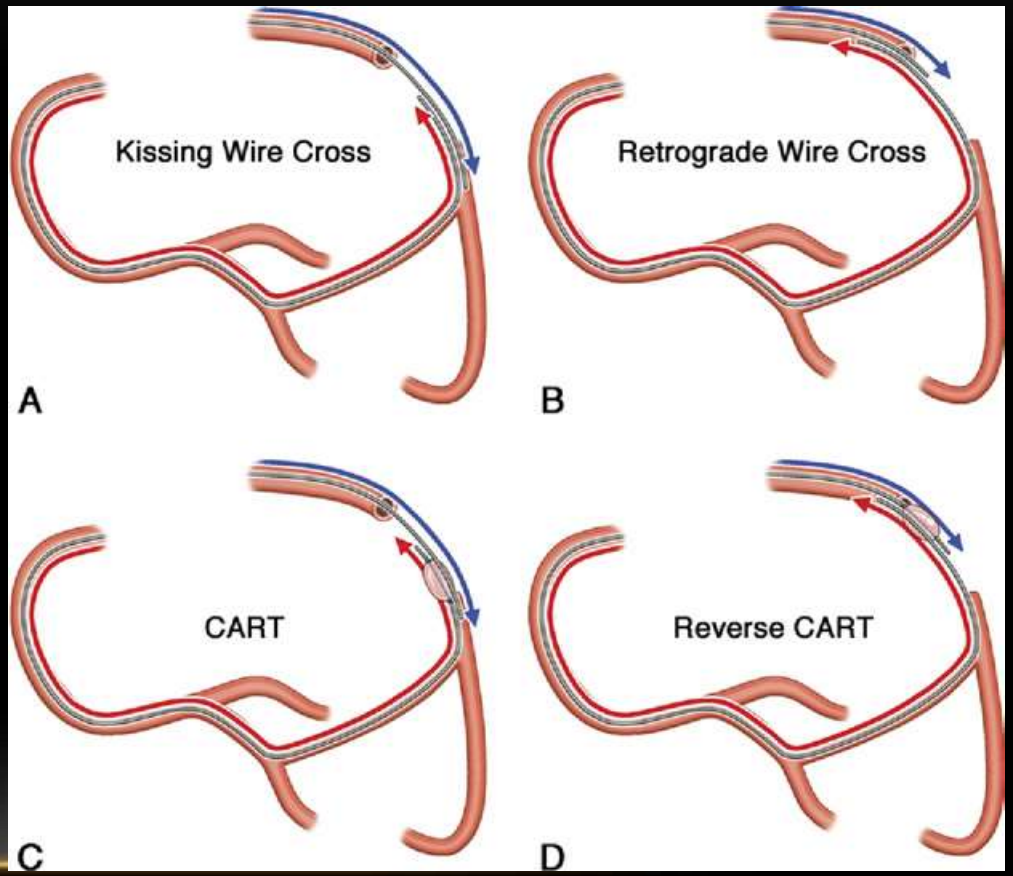
Procedure Results

	Ante 59	Retro 104	p value
Procedure time, min	105.2±60.1	187.7±81.9	<0.0001
Contrast dose, ml	226.8±111.0	291.6±133.8	0.0019
Fluoroscopic time, min	46.1±35.6	87.8±44.1	<0.0001
Procedure success	59 (100%)	104 (100%)	1.00
Procedure events	5.1% (3)	7.7% (8)	0.75
- GW perforation	5.1% (3)	5.8% (6)	1.00
- Channel injury	-	1.9% (2)	
- Donor artery trouble	-	0%	
In hospital MACE	0%	0%	1.00
Non Q wave MI	1 (1.7%)	2 (1.9%)	1.00

Retrograde Procedure

Patterns of Success



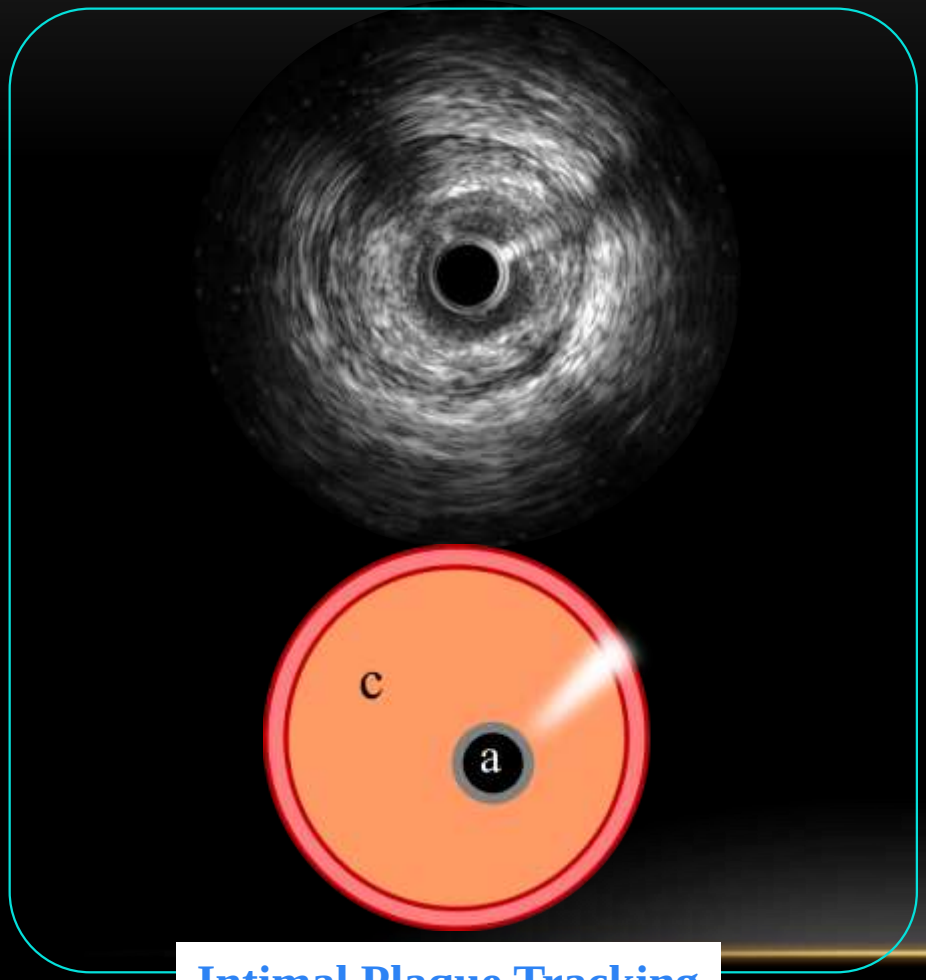


JACC. Cardiovasc Interv 2011;4:941-51

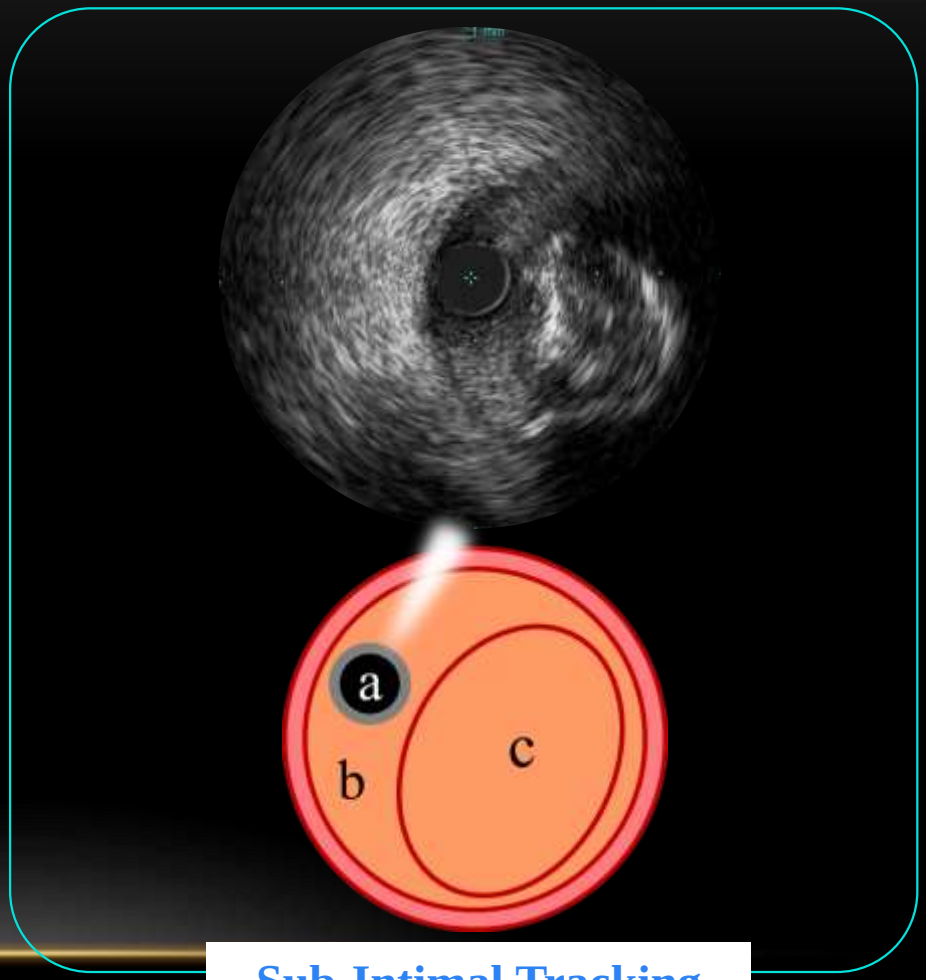
IVUS ANALYSIS RESULTS

IVUS Image

Intimal vs. Sub-Intimal Tracking



Intimal Plaque Tracking

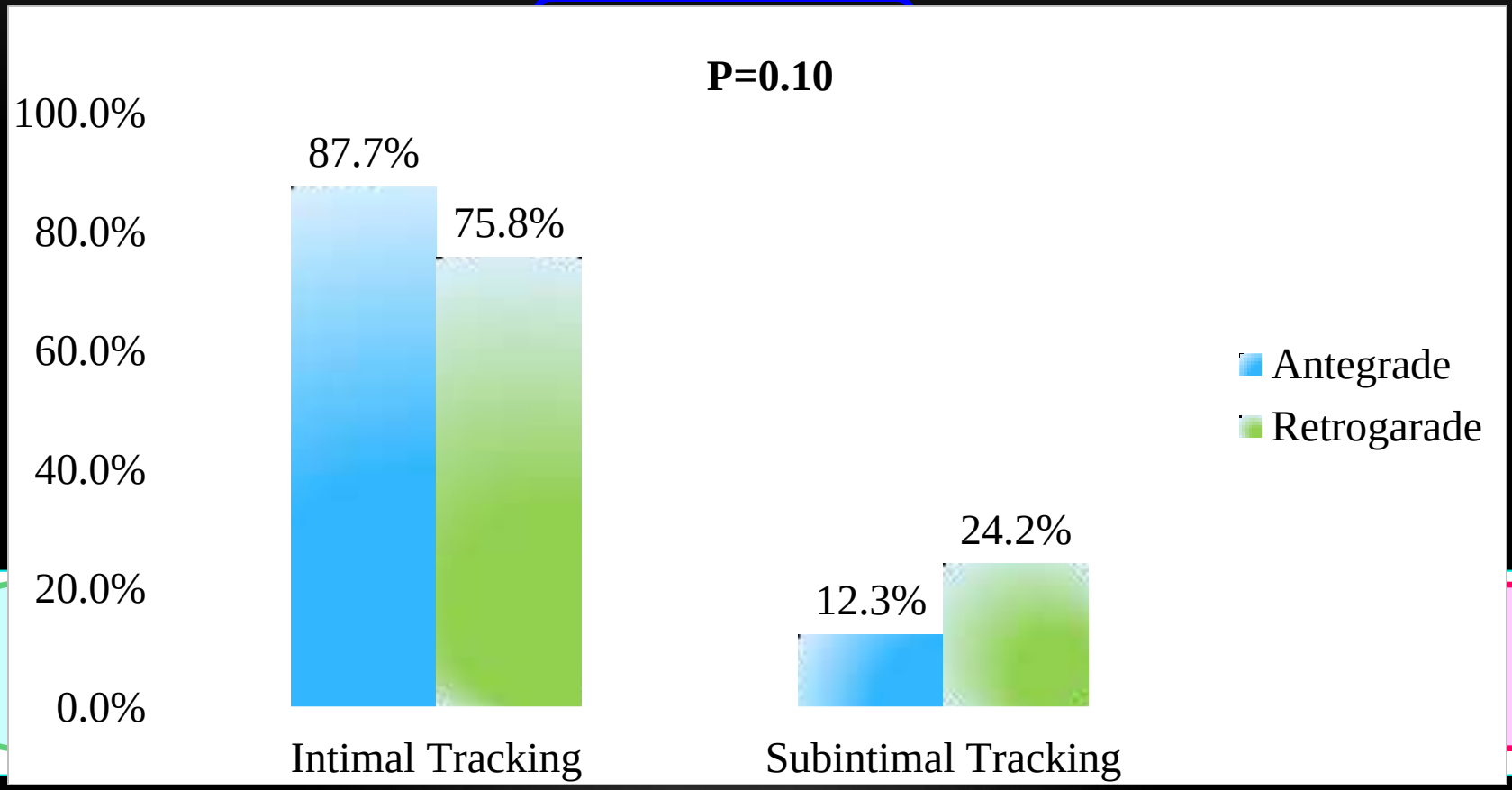


Sub-Intimal Tracking

a = IVUS catheter , b = Sub-Intimal space, c = the Intimal Plaque

Results

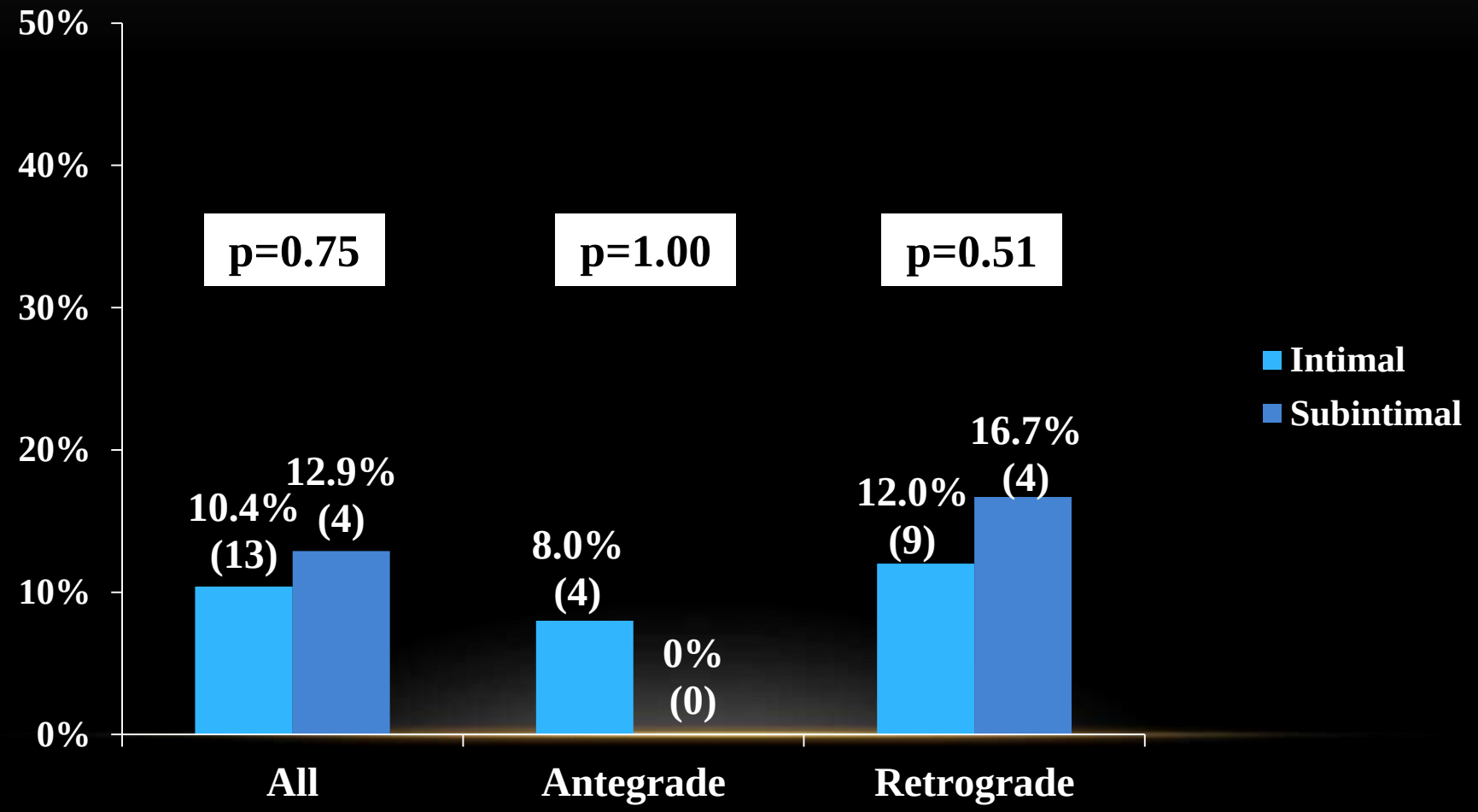
Acute IVUS classification



12-MONTH FU
CLINICAL RESULTS

TVR at 12 months

Antegrade (Intimal vs. Sub-intimal)
Retrograde (Intimal vs. Sub-intimal)



QCA RESULTS

Acute QCA Results
Intimal vs. Sub-Intimal

	Intimal (125)	Sub-Intimal (31)	p value
Pre Procedure			
RVD, mm	2.82±0.42	3.02±0.44	0.020
Occlusion Length, mm	18.5±14.8	23.9±20.5	0.14
Post Procedure(In stent)			
RVD, mm	3.09±0.48	3.17±0.44	0.38
MLD, mm	2.60±0.46	2.61±0.37	0.91
Stent Length, mm	50.5±23.8	60.5±23.0	0.040
Acute Gain, mm	2.6 ±0.5	2.6 ±0.4	0.91

9-month QCA Results
Intimal vs. Sub-Intimal

	Intimal (100)	Sub-Intimal (22)	p value
In Stent			
RVD, mm	3.00±0.46	2.95±0.41	0.87
MLD, mm	2.41±0.66	2.03±0.79	0.021
% DS, %	19.8±19.1	30.4±25.9	0.031
Late Loss, mm	0.21±0.52	0.57±0.93	0.016
Loss Index, %	7.8±22.6	19.7±30.3	0.038
Reocclusion	3.0% (3)	4.5% (1)	0.55
Aneurysm	1.0% (1)	9.1% (2)	0.08

Aneurysm (from QCA core lab) = an expansion of the lumen by at least 20% compared with the normal lumen dimensions in the treatment region (analysis segment) that extends with a wide or narrow mouth beyond the apparent normal contour

Acute QCA Results
Retrograde: Intimal vs. Sub-Intimal

	Intimal (75)	Sub-Intimal (24)	p value
Pre Procedure			
RVD, mm	2.89±0.41	3.08±0.43	0.06
Occlusion Length, mm	21.5±15.5	28.1±21.1	0.14
Post Procedure(In stent)			
RVD, mm	3.11±0.51	3.21±0.41	0.39
MLD, mm	2.60±0.48	2.63±0.41	0.74
Stent Length, mm	56.4±23.7	66.7±20.9	0.06
Acute Gain, mm	2.6±0.5	2.6±0.4	0.74

9-month QCA Results
Retrograde: Intimal vs. Sub-Intimal

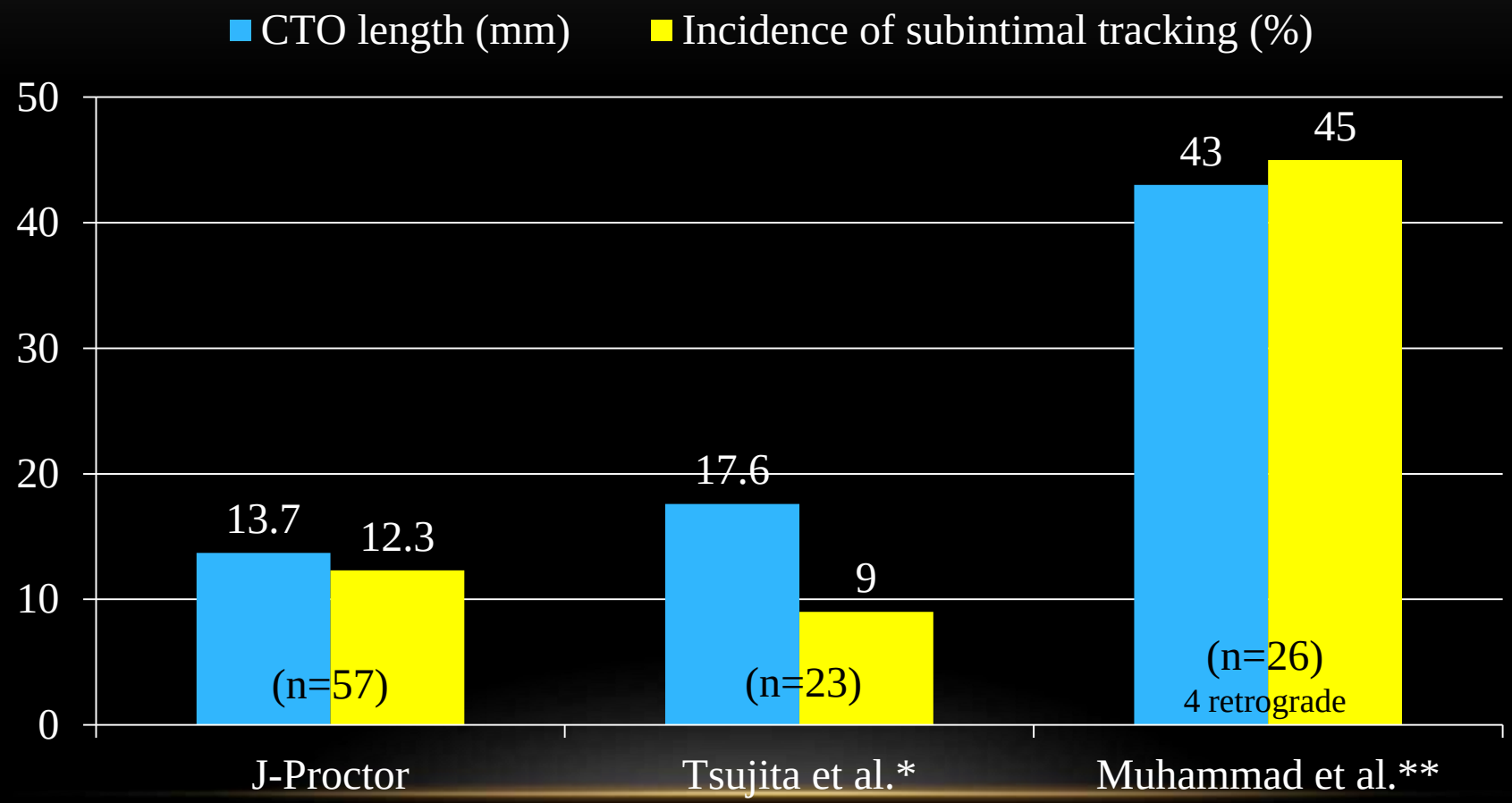
	Intimal 77.3% (58)	Sub-Intimal 75.0% (18)	p value
In Stent			
RVD, mm	3.02±0.49	3.00±0.43	0.86
MLD, mm	2.32±0.73	1.92±0.83	0.05
% DS, %	23.2±20.3	34.8±26.7	0.05
Late Loss, mm	0.29±0.63	0.71±0.98	0.037
Loss Index, %	10.8±24.9	24.6±31.4	0.06
Reocclusion	3.4% (2)	5.6% (1)	0.56
Aneurysm	1.7% (1)	11.1% (2)	0.14

Aneurysm (from QCA core lab) = an expansion of the lumen by at least 20% compared with the normal lumen dimensions in the treatment region (analysis segment) that extends with a wide or narrow mouth beyond the apparent normal contour

Lessons from J-PROCTOR

1. Subintimal tracking is more predictable in the retrograde approach than the antegrade. But not so common even if reverse CART is commonly used (>50%).
2. Occlusion length may influence the incidence of subintimal tracking in both approaches.

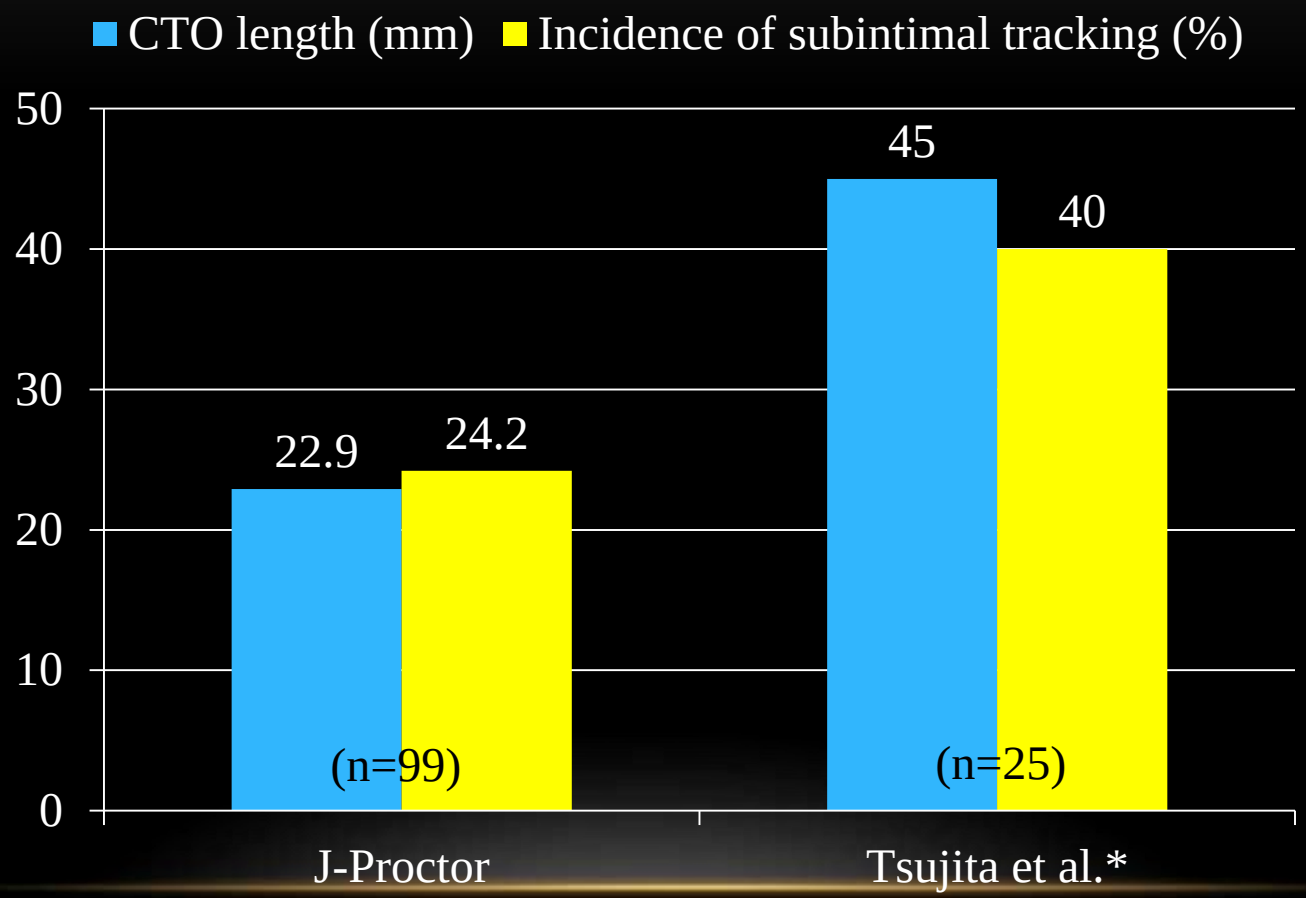
CTO length and Subintimal tracking
Antegrade approach



*(*JACC Intv 2009;2:846-54)*
*(**CCI 2012;79:43-48)*

CTO length and Subintimal tracking

Retrograde approach



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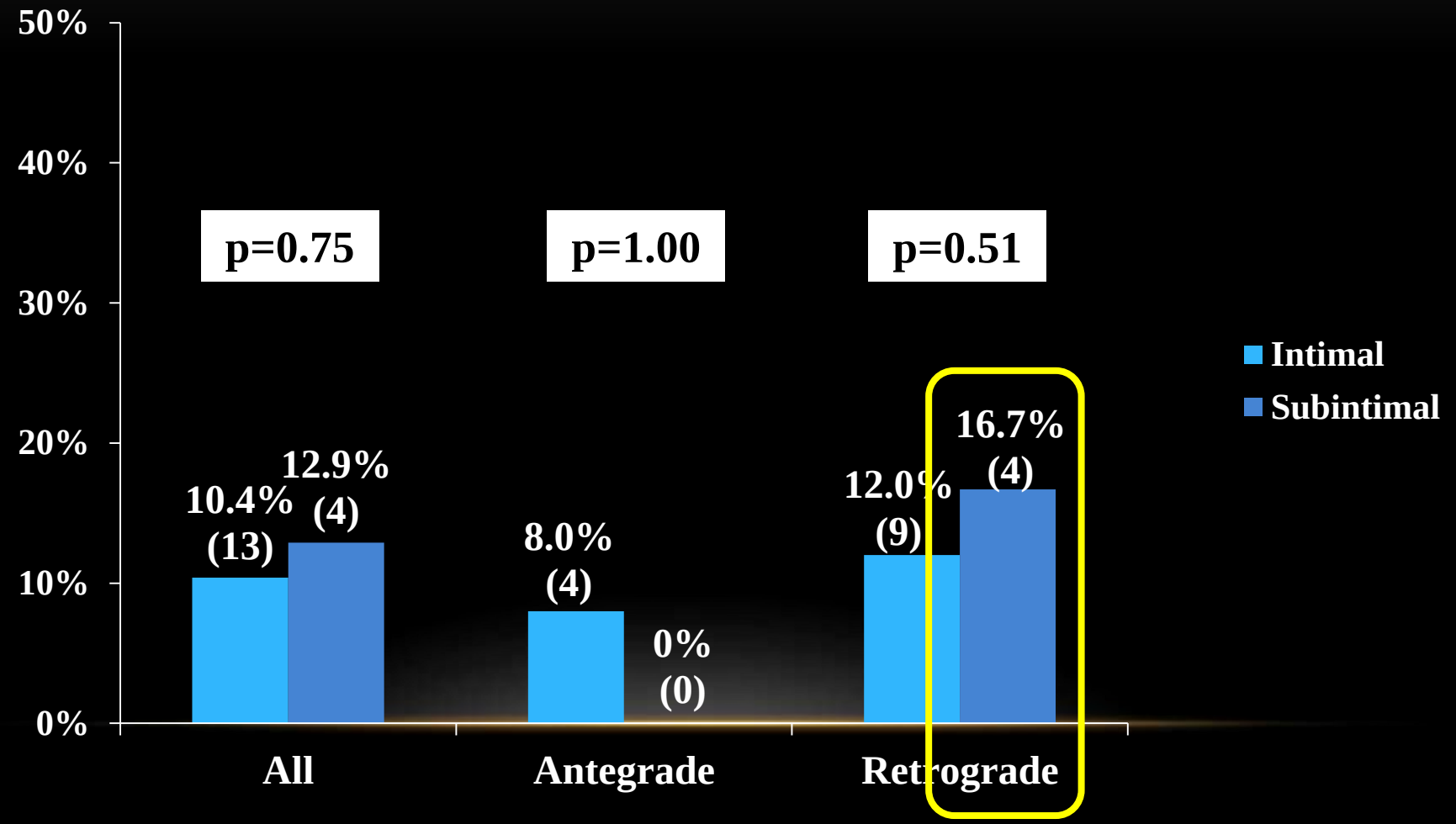
Lessons from J-PROCTOR

1. Subintimal tracking is more predictable in the retrograde approach than the antegrade. But not so common even if reverse CART is commonly used (>50%).
2. Occlusion length may influence the incidence of subintimal tracking in both approaches.
3. Restenosis does not always occur in DES with subintimal dilatation.

TVR at 12 months

Antegrade (Intimal vs. Sub-intimal)
Retrograde (Intimal vs. Sub-intimal)

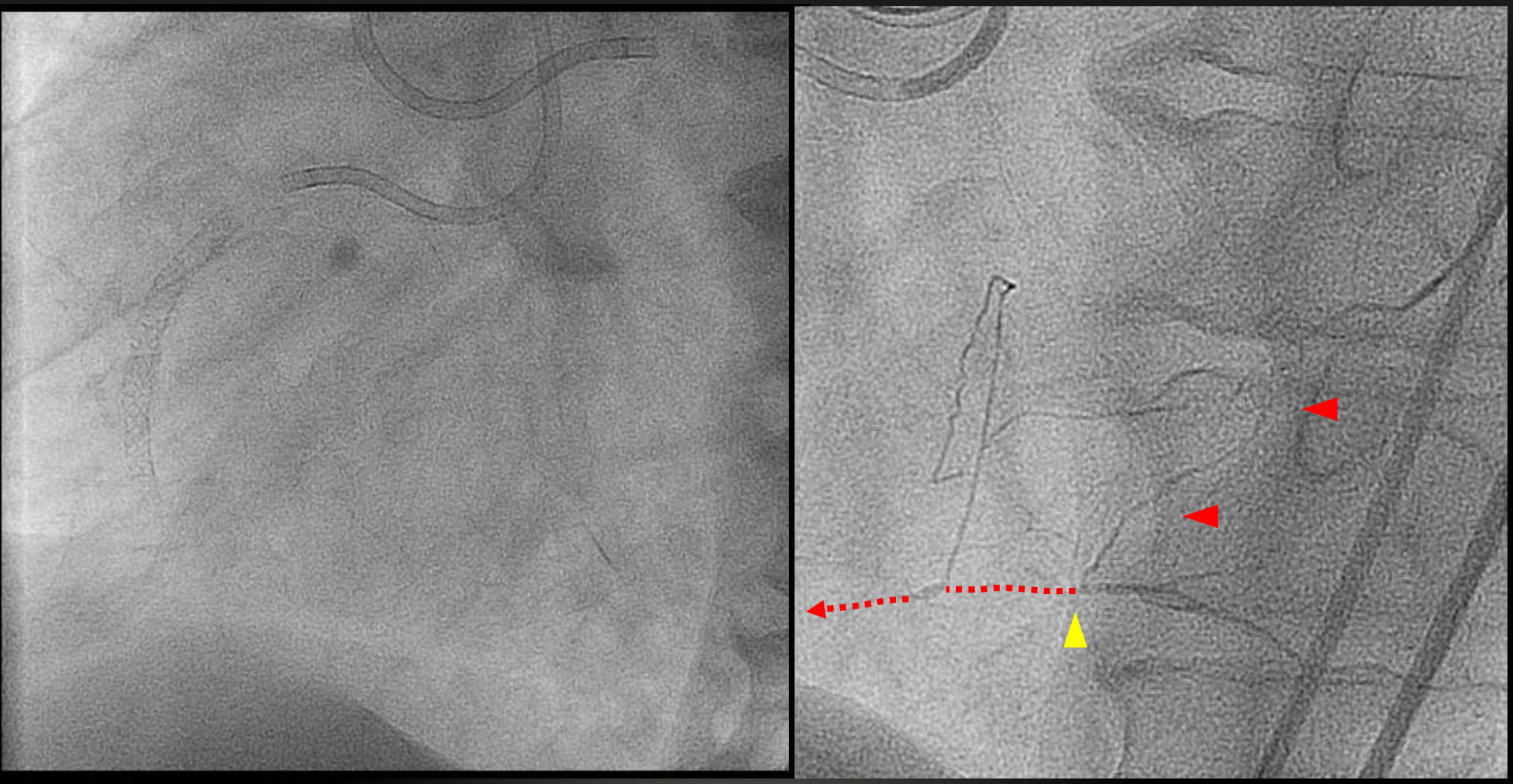


9-month QCA Results
Retrograde: Intimal vs. Sub-Intimal

	Intimal 77.3% (58)	Sub-Intimal 75.0% (18)	p value
In Stent			
RVD, mm	3.02±0.49	3.00±0.43	0.86
MLD, mm	2.32±0.73	1.92±0.83	0.05
% DS, %	23.2±20.3	34.8±26.7	0.05
Late Loss, mm	0.29±0.63	0.71±0.98	0.037
Loss Index, %	10.8±24.9	24.6±31.4	0.06
Reocclusion	3.4% (2)	5.6% (1)	0.56
Aneurysm	1.7% (1)	11.1% (2)	0.14

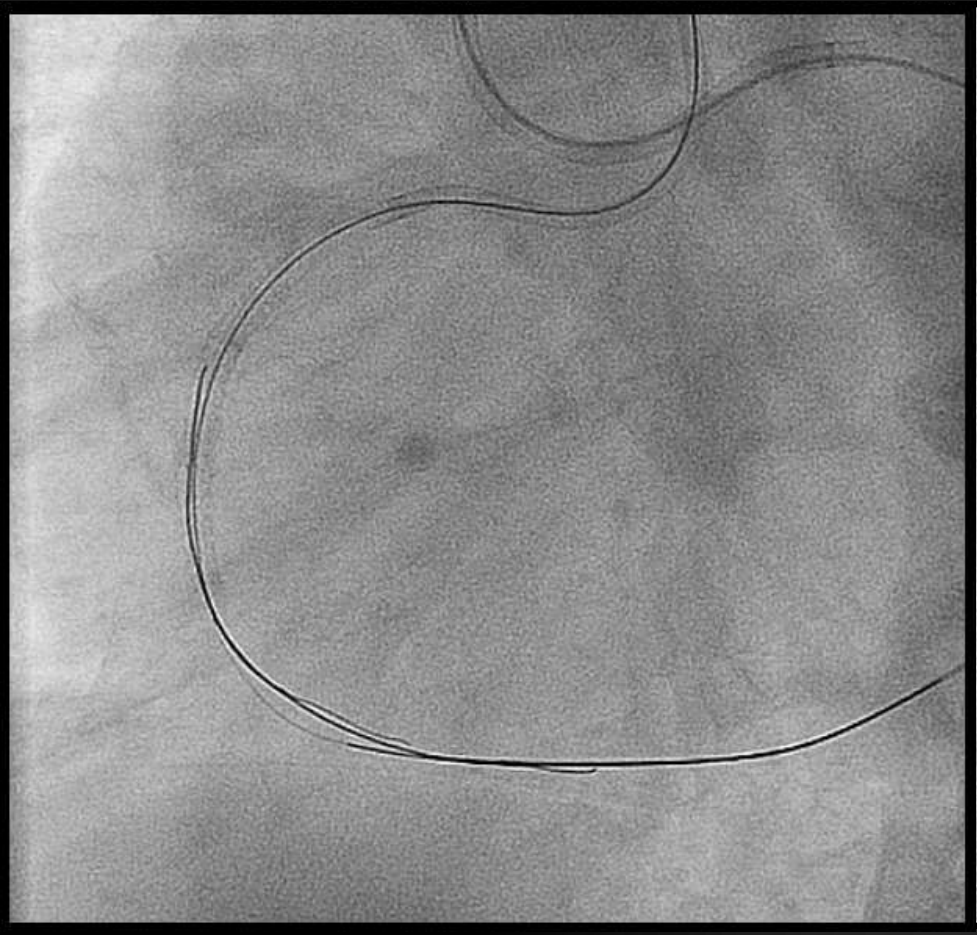
Aneurysm (from QCA core lab) = an expansion of the lumen by at least 20% compared with the normal lumen dimensions in the treatment region (analysis segment) that extends with a wide or narrow mouth beyond the apparent normal contour

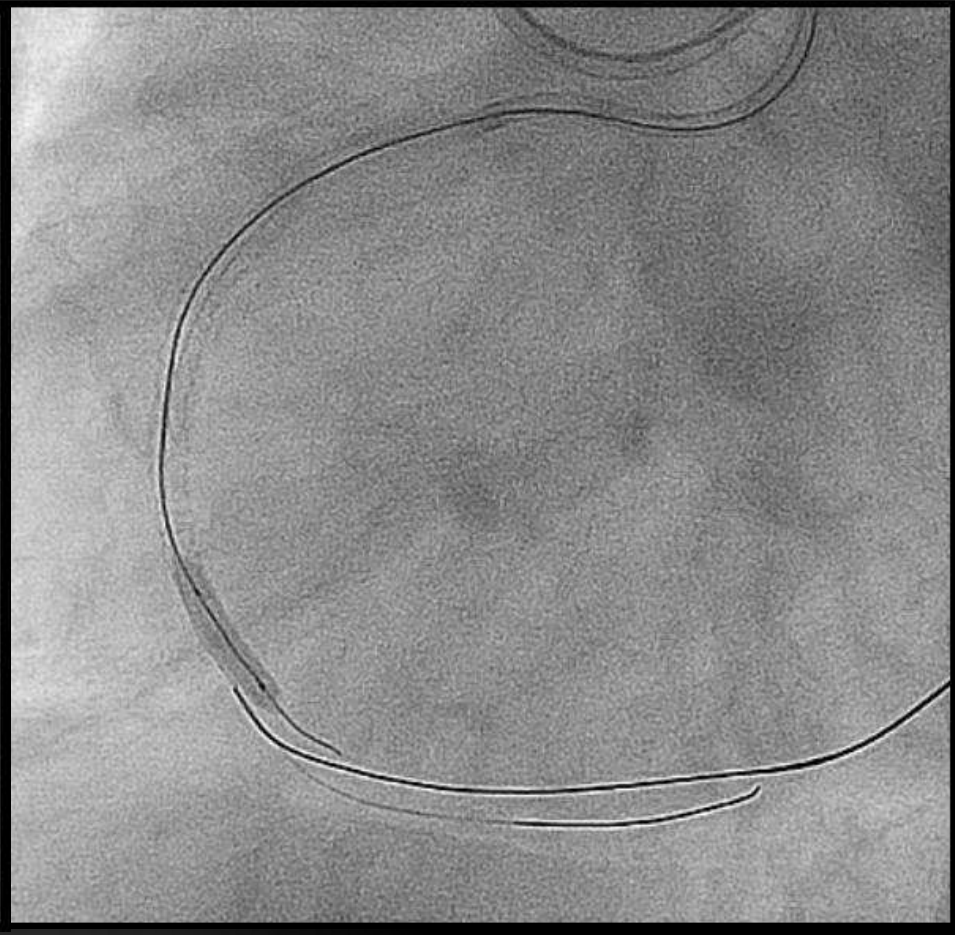
TVR Case in Retrograde Group #1



Epicardial channel

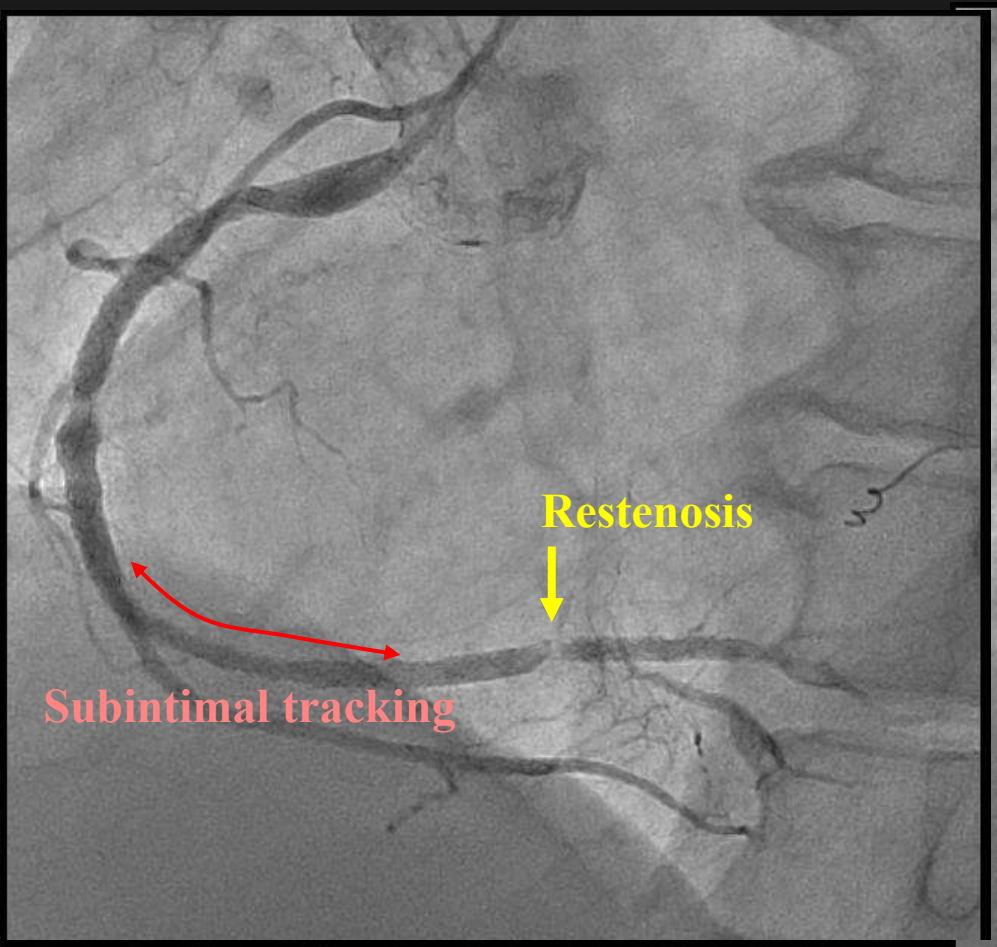
TVR Case in Retrograde Group #1

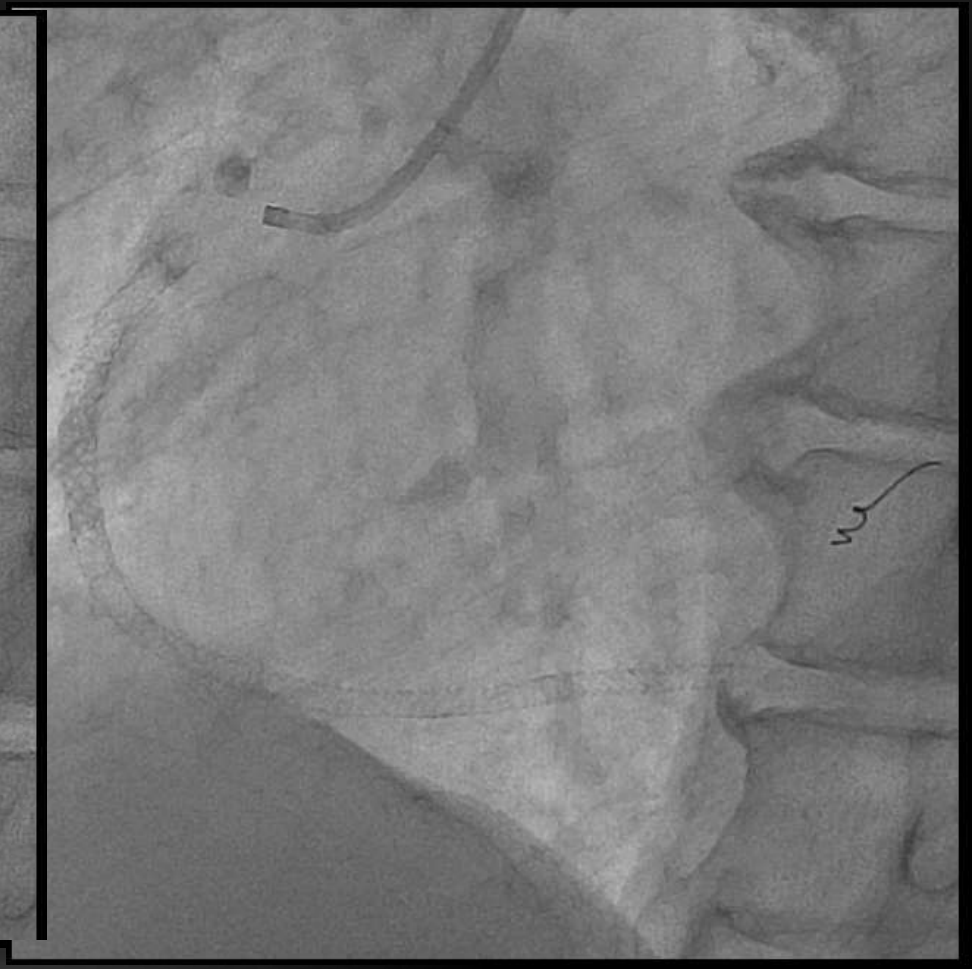




Reverse CART

TVR Case in Retrograde Group #1

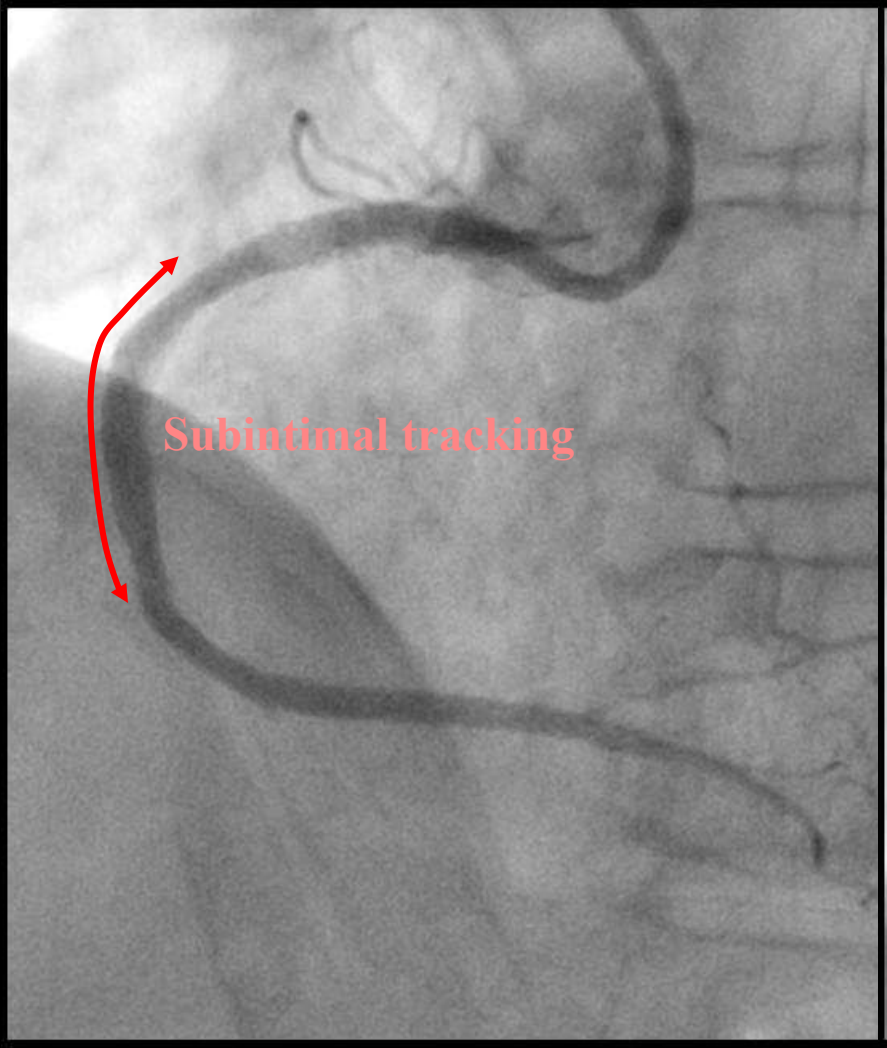


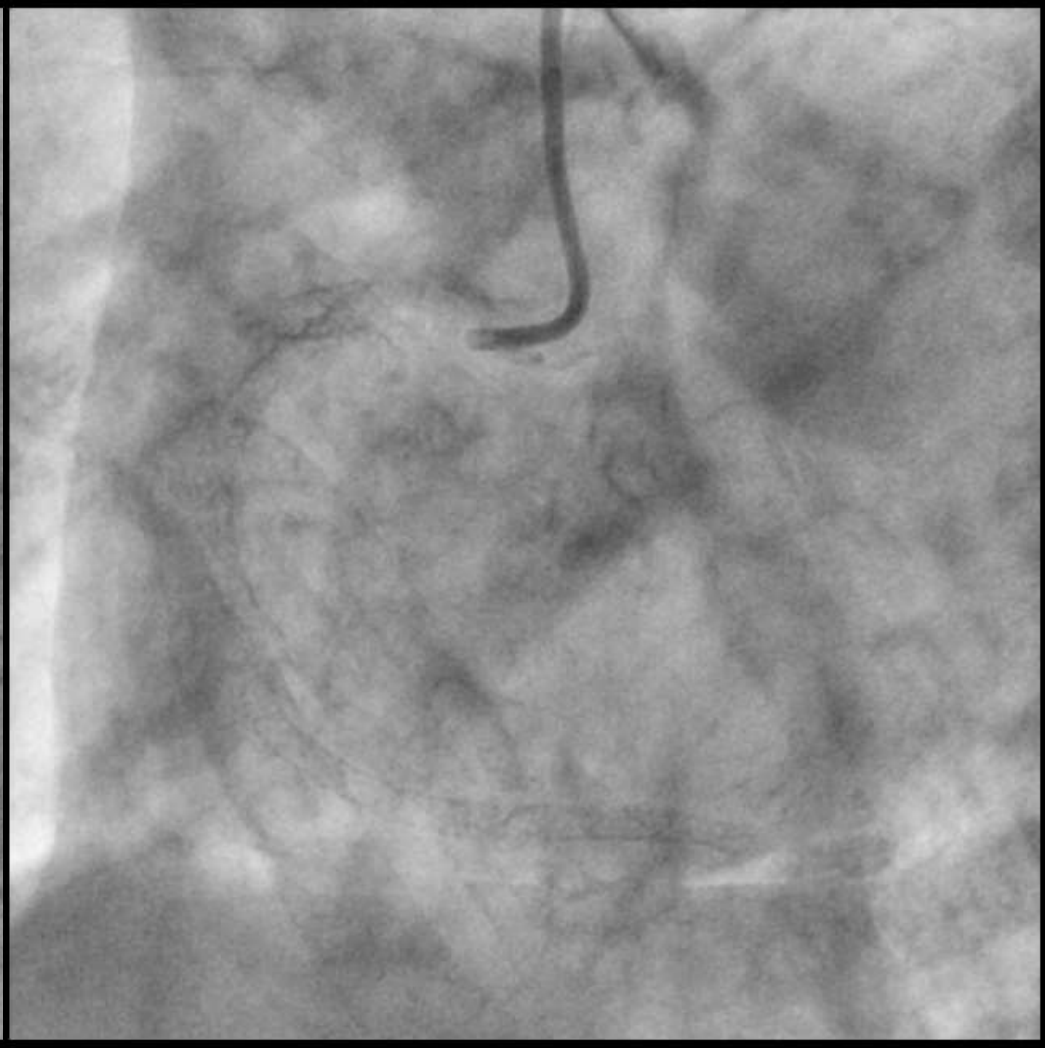


Final angiogram

9Mo Fu angiogram

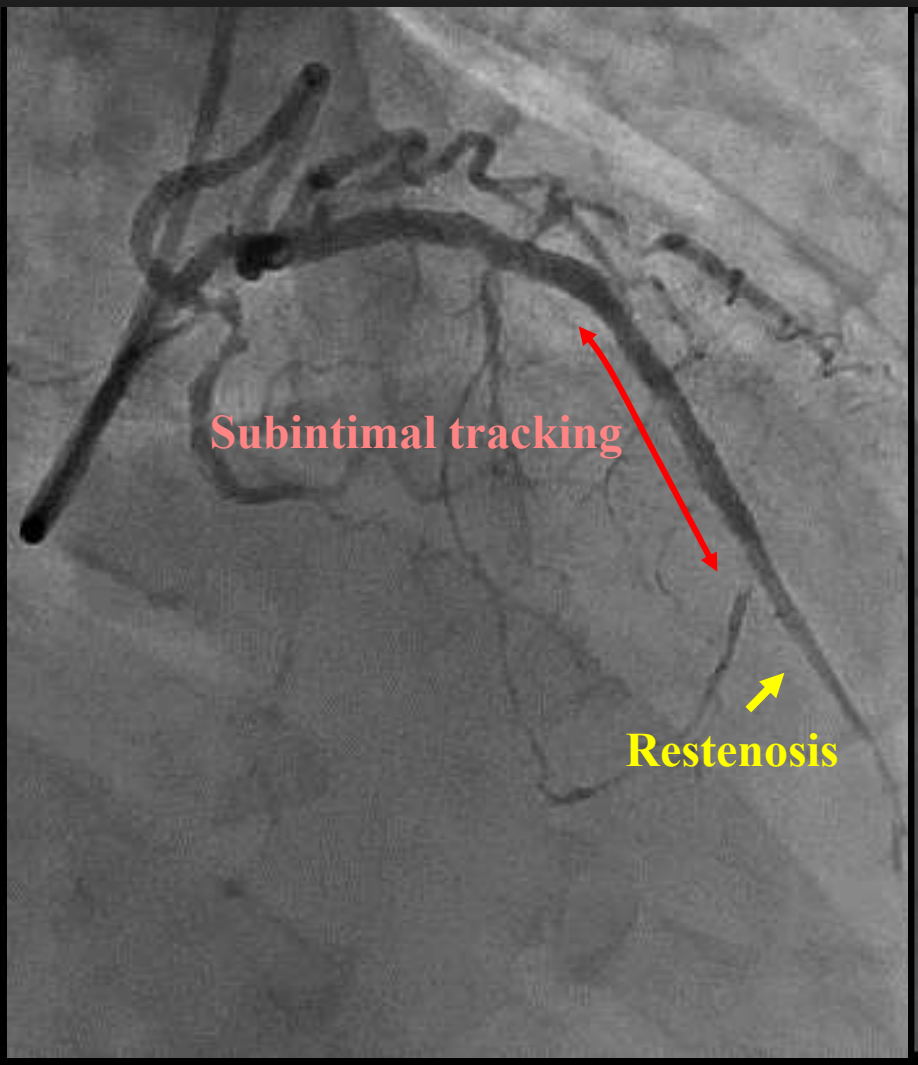
TVR Case in Retrograde Group #2

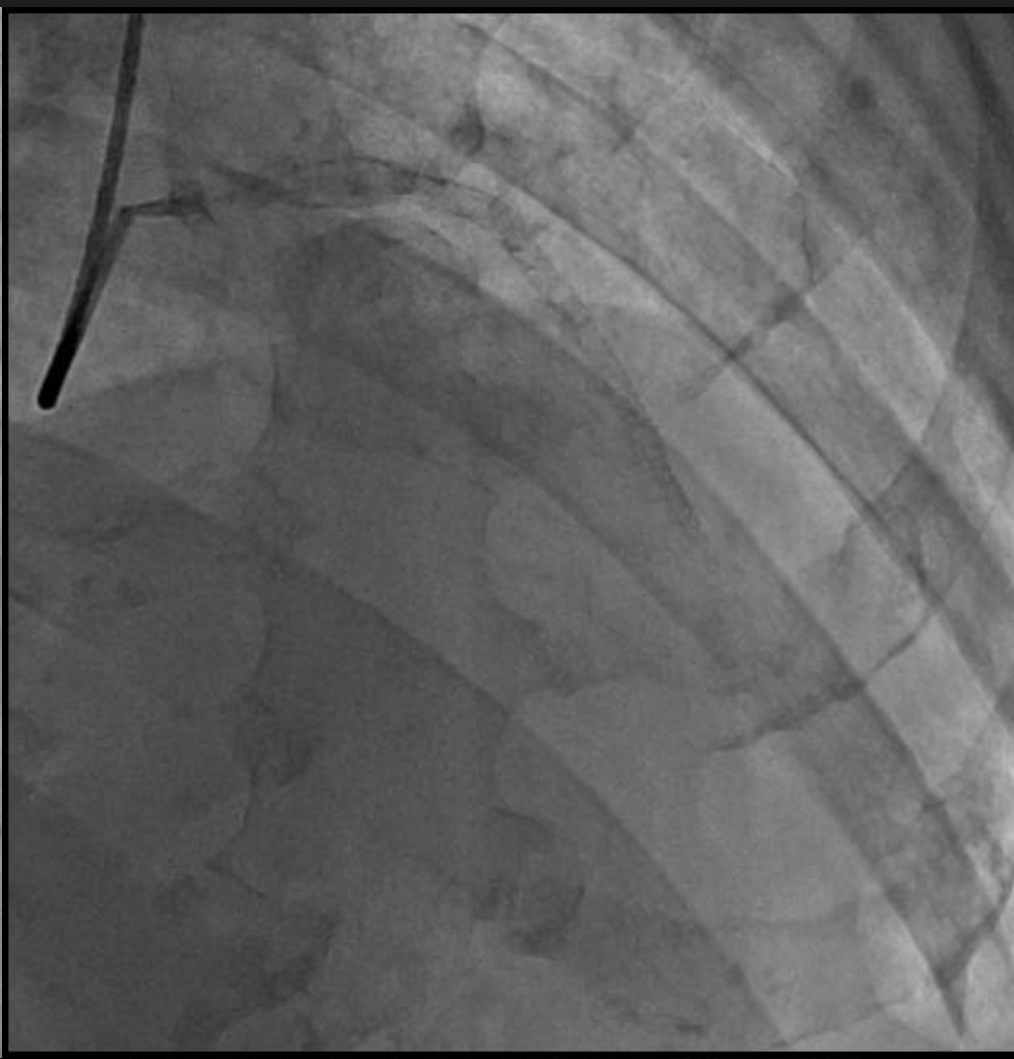




9Mo Fu angiogram

TVR Case in Retrograde Group #3





9Mo Fu angiogram

Lessons from J-PROCTOR

1. Subintimal tracking is more predictable in the retrograde approach than the antegrade. But not so common even if reverse CART is commonly used (>50%).
2. Occlusion length may influence the incidence of subintimal tracking in both approaches.
3. Restenosis does not always occur in DES with subintimal dilatation.
4. Localized subintimal tracking and a final TIMI flow grade 3 with well preserved distal side branches may not worsen the vessel patency.

Antegrade or Retrograde?

- Approaching strategy highly depends on patient and lesion characteristics.
- Retrograde procedural outcomes are related to availability of interventional collateral but not to operator experience.
- High experienced operators have a better antegrade manner including IVUS guided wiring.
- Retrograde approach using septal dilatation or channel dilator causes myocardial injury.
- Localized subintimal tracking may not affect clinical follow-up outcomes in both approaches.

16th CTO Club

June 19-20, 2015, Nagoya, Japan

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