

J-CTO score:



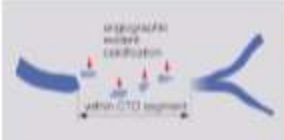

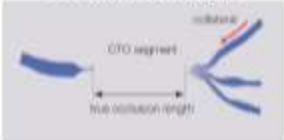

Old-fashioned vs. Endless uploaded value

Kenya Nasu, MD, FACC
Toyohashi Heart Center, Japan

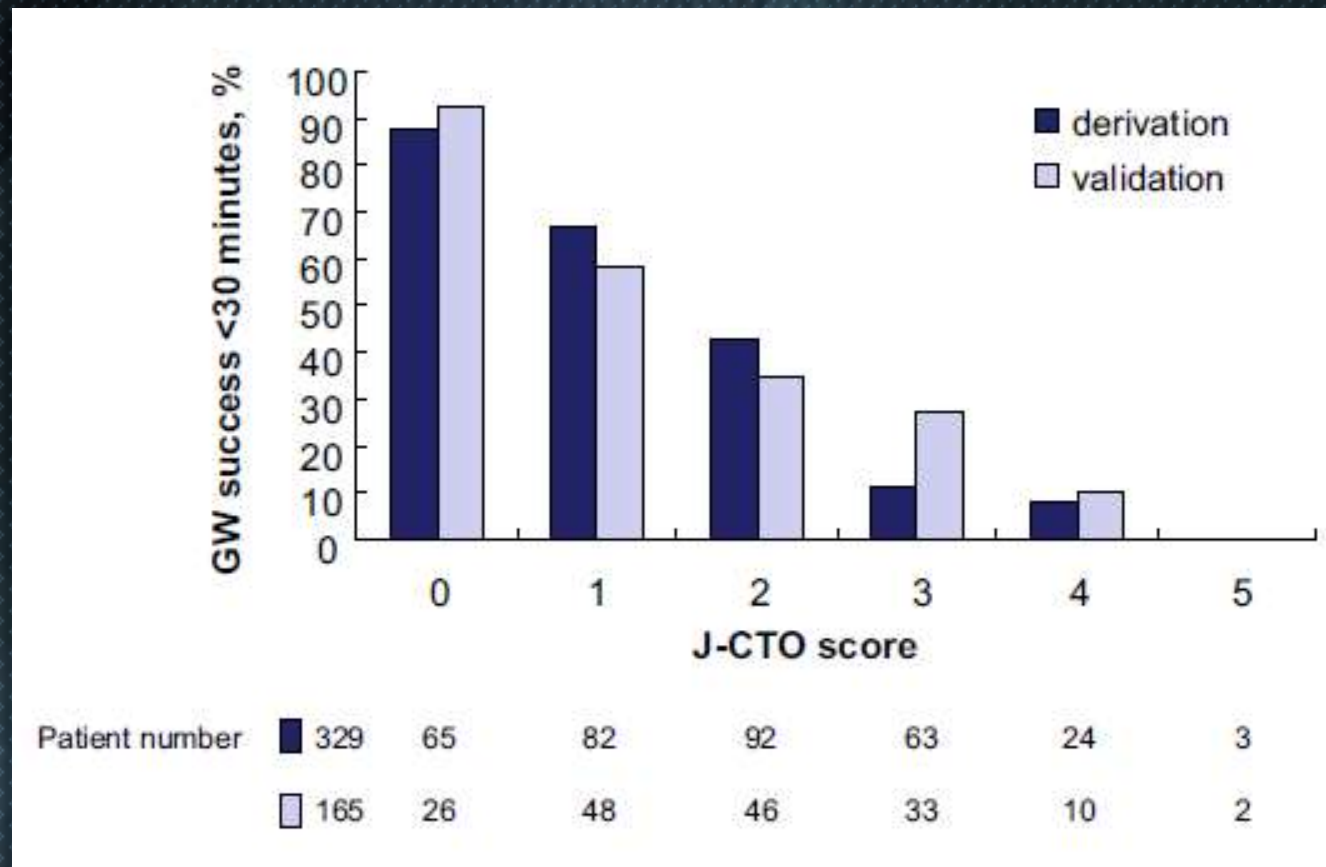
- **Several scoring systems have been developed to determine the likelihood of CTO PCI technical success and the potential difficulty of the procedure.**
- **The Japanese CTO (J-CTO) score is the most widely applied and accepted score used to assess complexity, which is based on the presence of certain angiographic characteristics.**

J-CTO SCORE SHEET

Version 1.0

Variables and definitions		
Tapered 	Blunt 	Entry shape <input type="checkbox"/> Tapered (0) <input type="checkbox"/> Blunt (1) Entry with any tapered tip or dimple indicating direction of true lumen is categorized as "tapered". point
Calcification 	Regardless of severity, 1 point is assigned if any evident calcification is detected within the CTO segment.	Calcification <input type="checkbox"/> Absence (0) <input type="checkbox"/> 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° <input type="checkbox"/> Absence (0) <input type="checkbox"/> Presence (1) point
Occlusion length 	Using good collateral images, try to measure "true" distance of occlusion, which tends to be shorter than the first impression.	Occl.Length <input type="checkbox"/> <20mm (0) <input type="checkbox"/> ≥20mm (1) point
Re-try lesion Is this Re-try (2 nd attempt) lesion? (previously attempted but failed)		Re-try lesion <input type="checkbox"/> No (0) <input type="checkbox"/> Yes (1) point
Category of difficulty (total point) <input type="checkbox"/> easy (0) <input type="checkbox"/> intermediate (1) <input type="checkbox"/> difficult (2) <input type="checkbox"/> very difficult (≥3)		Total  points

Although this scoring system is usually considered as a model to predict the difficulty of CTO PCI, it is originally developed to predict successful **guidewire crossing within 30 min.**



Outcomes of Percutaneous Coronary Interventions for Chronic Total Occlusion Performed by Highly Experienced Japanese Specialists

The First Report From the Japanese CTO-PCI Expert Registry

Yoriyasu Suzuki, MD,^a Etsuo Tsuchikane, MD, PhD,^b Osamu Katoh, MD,^c Toshiya Muramatsu, MD,^d Makoto Muto, MD,^e Koichi Kishi, MD,^f Yuji Hamazaki, MD,^g Yuji Oikawa, MD,^h Tomohiro Kawasaki, MD,ⁱ Atsunori Okamura, MD^j

J Am Coll Cardiol Intv 2017;10:2144–54

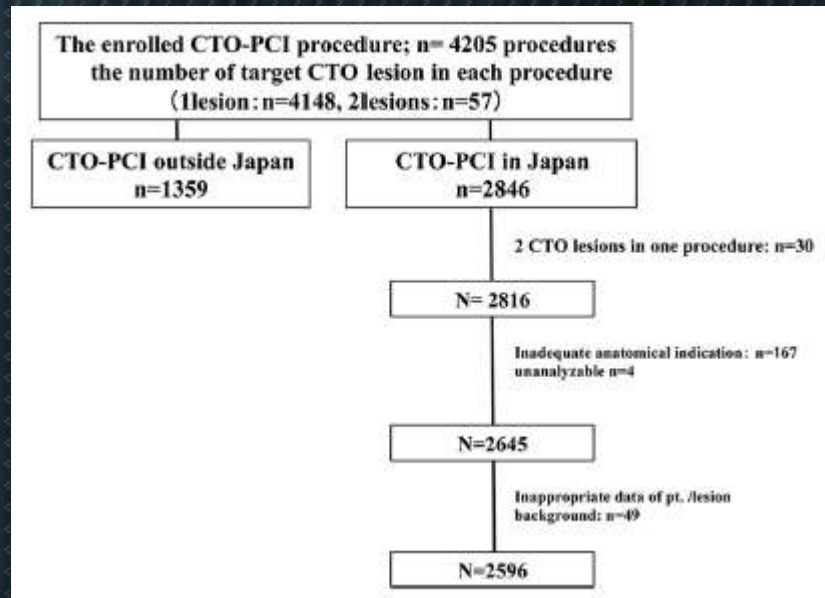


TABLE 1 Baseline Patient Characteristics and Baseline Angiographic Characteristics

	Overall (N = 2,596)	PAA (n = 1,872)	PRA (n = 724)	PAA vs. PRA p Value
Age, yrs	66.9 ± 10.9	66.8 ± 10.9	66.9 ± 10.7	0.863
BMI, kg/m ²	24.7 ± 3.8	24.7 ± 3.8	24.6 ± 3.8	0.413
LVEF	54.8 ± 12.9	54.9 ± 12.9	54.6 ± 12.8	0.458
eGFR	64.9 ± 29.0	65.1 ± 30.2	64.3 ± 25.7	0.458
Male	86.1	85.1	88.4	0.018
Hypertension	78.5	78.0	80.8	0.12
Dyslipidemia	77.5	76.1	82.1	0.001
Diabetes	44.9	44.9	45.8	0.35
Current smoking	54.4	58.0	62.3	0.057
OMI	51.0	51.7	51.3	0.895
Prior CABG	7.9	7.4	9.4	0.105
Prior PCI	63.2	61.8	67.5	0.007
Reattempt	20.6	15.1	34.8	<0.0001
Syntax score	15.9 ± 8.6	16.0 ± 8.4	15.6 ± 8.9	0.062
J-CTO score	2.0 ± 1.1	1.9 ± 1.1	2.4 ± 1.1	<0.0001
Number of diseased vessels				0.015
Single VD	49.1	50.6	45.1	
Double VD	30.1	28.8	33.5	
Triple VD	17.1	17.3	16.6	
LMT + multiple VD	3.8	3.3	4.9	
Target vessel				<0.0001
LAD	30.9	32.9	25.7	
LCX	17.1	20.4	8.6	
LMT	0.6	0.6	0.6	
RCA	51.5	46.2	65.2	
In-stent occlusion	13.6	16.9	5.1	<0.0001
Distal runoff <3.0 mm	65.0	64.9	67.2	0.274
CTO length ≥20 mm	60.5	57.0	69.6	<0.0001
Side branch at proximal cap	34.1	34.8	32.0	0.181
Collateral filling				<0.0001

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Makoto

Atsuo

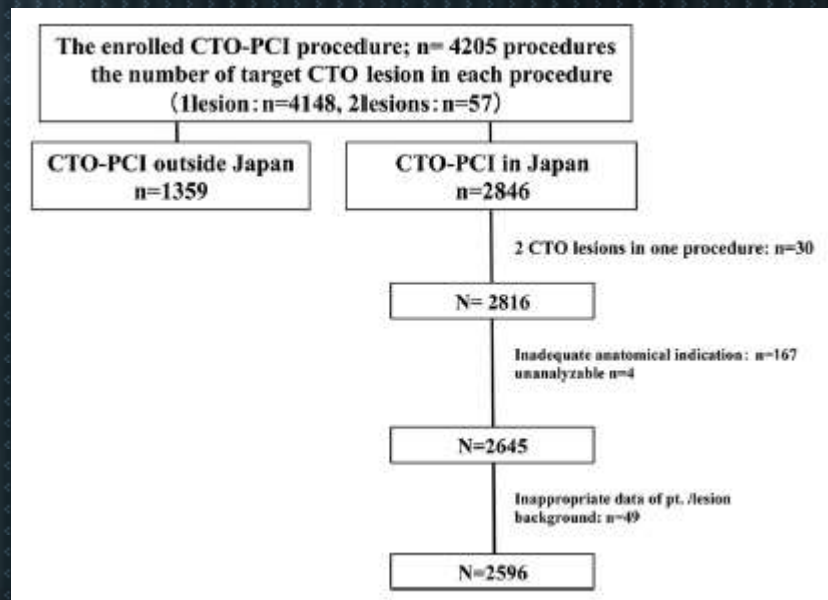
GW crossing within 30 min was observed in only 54% of CTO lesion with J-CTO score 0.

TABLE 1 Baseline Patient Characteristics and Baseline Angiographic Characteristics

	Overall (N = 2,596)	PAA (n = 1,872)	PRA (n = 724)	PAA vs. PRA p Value
Age, yrs	66.9 ± 10.9	66.8 ± 10.9	66.9 ± 10.7	0.863
BMI, kg/m ²	24.7 ± 3.8	24.7 ± 3.8	24.6 ± 3.8	0.412
LVEF	54.8 ± 12.9	54.9 ± 12.9	54.8 ± 12.9	0.912
eGFR	64.9 ± 29.0	65.1 ± 30.0	64.9 ± 29.0	0.912
Male	86.1	85.1	86.1	0.912
Hypertension	78.5	78.0	78.5	0.912
Dyslipidemia	77.5	76.1	77.5	0.912
Diabetes	44.9	44.9	44.9	0.912
Current smoking	54.4	58.0	54.4	0.912

TABLE 4 The Differences Between Successful and Failed Cases

	Overall		p Value
	Success (n = 2,209)	Failure (n = 278)	
Dyslipidemia	77.6	76.5	0.531
Prior CABG	7.2	14.7	<0.0001
Prior PCI	62.0	70.9	0.014



	Overall (n = 2,596)	PAA (n = 1,872)	PRA (n = 724)
Number of diseased vessels			
Single VD	49.1	50.6	49.1
Double VD	30.1	28.8	30.1
Triple VD	17.1	17.3	17.1
LMT + multiple VD	3.8	3.3	3.8
Target vessel			
LAD	30.9	32.9	30.9
LCX	17.1	20.4	17.1
LMT	0.6	0.6	0.6
RCA	51.5	46.2	51.5
In-stent occlusion	13.6	16.9	13.6
Distal runoff <3.0 mm	65.0	64.9	65.0
CTO length ≥20 mm	60.5	57.0	60.5
Side branch at proximal cap	34.1	34.8	34.1
Collateral filling			

	Overall (n = 2,596)	PAA (n = 1,872)	PRA (n = 724)	p Value
In-stent occlusion	13.9	11.9	13.9	0.361
Distal run off <3.0 mm	66.0	60.4	66.0	0.036
CTO length ≥20 mm	58.8	71.6	58.8	<0.0001
Side branch at proximal cap	33.4	36.7	33.4	0.269
Collateral filling				0.008
Contralateral	50.9	52.5	50.9	
Ipsilateral	13.7	9.4	13.7	
Both	35.3	36.0	35.3	
None	0.6	2.2	0.6	
Severe lesion calcification	5.4	18.3	5.4	<0.0001
Proximal tortuosity				<0.0001
Straight	51.4	44.2	51.4	
Mild	35.1	32.0	35.1	
Moderate	11.3	19.8	11.3	
Severe	2.0	3.6	2.0	
Tortuosity of CTO lesion	22.8	39.9	22.8	<0.0001
Morphology of proximal cap				0.01
Blunt	23.7	23.7	23.7	
No stump	18.7	23.0	18.7	
Tapered/tunnel	57.2	51.4	57.2	

Values are % or mean ± SD.
Abbreviations: as in Table 1.

Chronic Total Occlusion Percutaneous Coronary Intervention: Evidence and Controversies

Peter Tajti, MD; Emmanouil S. Brilakis, MD, PhD

J Am Heart Assoc. 2018;7:e006732

Score Variables	J-CTO Score ³⁶	CL Score ³⁴	PROGRESS-CTO Score ³⁸	ORA Score ³⁷	RECHARGE Score ³⁹	Ellis Score ³⁵
No. of cases	494	1657	781	1073	1253	456
End point	Guidewire crossing <30 min	Technical success	Technical success	Technical success	Technical success	Technical success
Age, y	–	–	–	+ (≥75)	+ (>65)	–
Prior CABG	–	+	–	–	+	–
Prior failure	+	–	–	–	–	–
Proximal cap	+ (Blunt)	+ (Blunt)	+ (Ambiguous)	+ (Ostial)	+	+ (Ambiguous, ostial)
Tortuosity	+ (>45° in lesion)	–	+ (Moderate,* proximal)	–	+	+
Calcification	+	+ (Severe)	–	–	+	+
Lesion length	+ (≥20 mm)	+ (≥20 mm)	–	–	+	+
Target vessel	–	+ (Non-LAD)	+ (LCX)	–	–	+ (Poor distal target)
Collateral quality	–	–	+ (Interventional)	+ (Rentrop <2)	–	+†
Other	–	Prior myocardial infarction	–	–	BMI >30 kg/m ² , nonproximal location	Operator experience

A Clinical and Angiographic Scoring System to Predict the Probability of Successful First-Attempt Percutaneous Coronary Intervention in Patients With Total Chronic Coronary Occlusion



Giuseppe Alessandrino, MD, Bernard Chevalier, MD, Thierry Lefèvre, MD, Francesca Sanguineti, MD, Philippe Garot, MD, Thierry Untersee, MD, Thomas Hovasse, MD, Marie-Claude Morice, MD, Yves Louvard, MD

J Am Coll Cardiol Intv 2017;10:2144–54

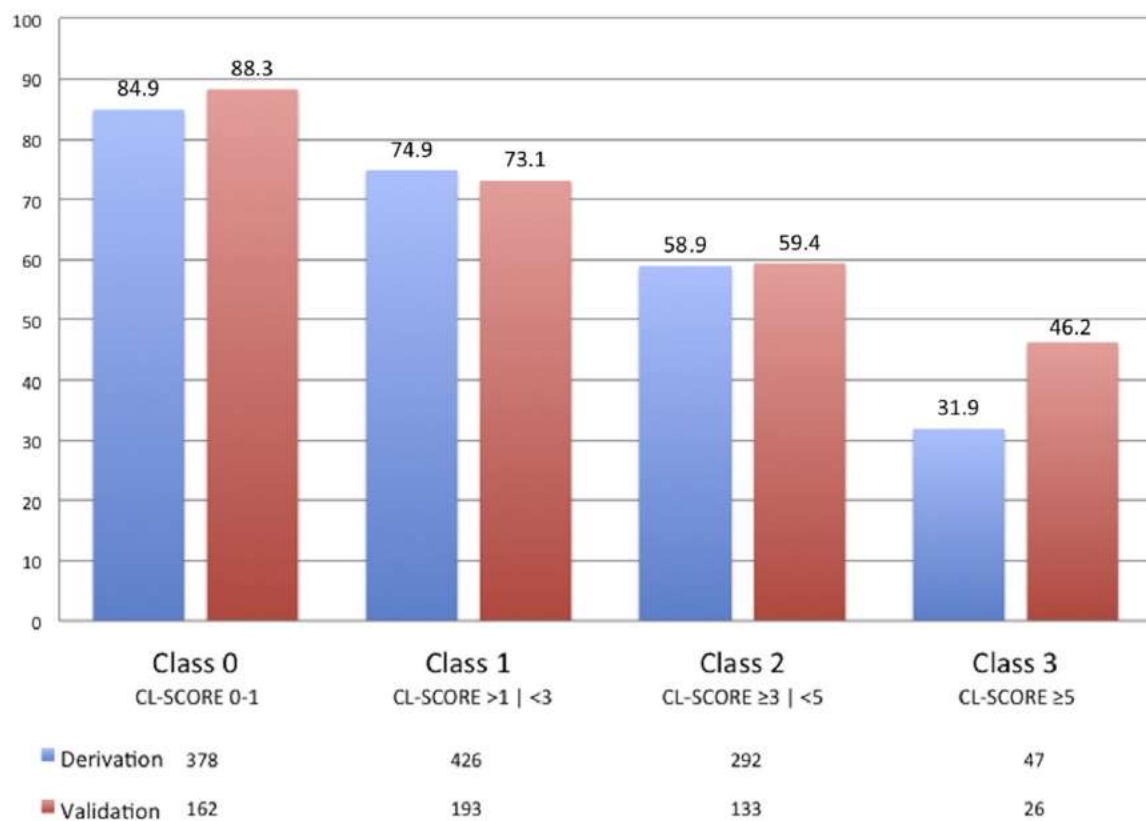
RESULTS The overall procedural success rate was 72.5%. Independent predictors of CTO-PCI failure were identified and included in the clinical and lesion-related score (CL-score) as follows: ^① previous coronary artery bypass graft surgery +1.5 (odds ratio [OR]: 2.49, 95% confidence interval [CI]: 1.56 to 3.96), ^② previous myocardial infarction +1 (OR: 1.6, 95% CI: 1.17 to 2.2), ^③ severe lesion calcification +2 (OR: 2.72, 95% CI: 1.78 to 4.16), ^④ longer CTOs +1.5 (≥ 20 mm OR: 2.04, 95% CI: 1.54 to 2.7), ^⑤ non-left anterior descending coronary artery location +1 (OR: 1.56, 95% CI: 1.14 to 2.15), and ^⑥ blunt stump morphology +1 (OR: 1.39, 95% CI: 1.05 to 1.81). Score values of 0 to 1, >1 and <3 , ≥ 3 and <5 , and ≥ 5 identified subgroups at high, intermediate, low, and very low probability, respectively, of CTO-PCI success (derivation cohort: 84.9%, 74.9%, 58%, and 31.9%; $p < 0.0001$; validation cohort: 88.3%, 73.1%, 59.4%, and 46.2%; $p < 0.0001$).

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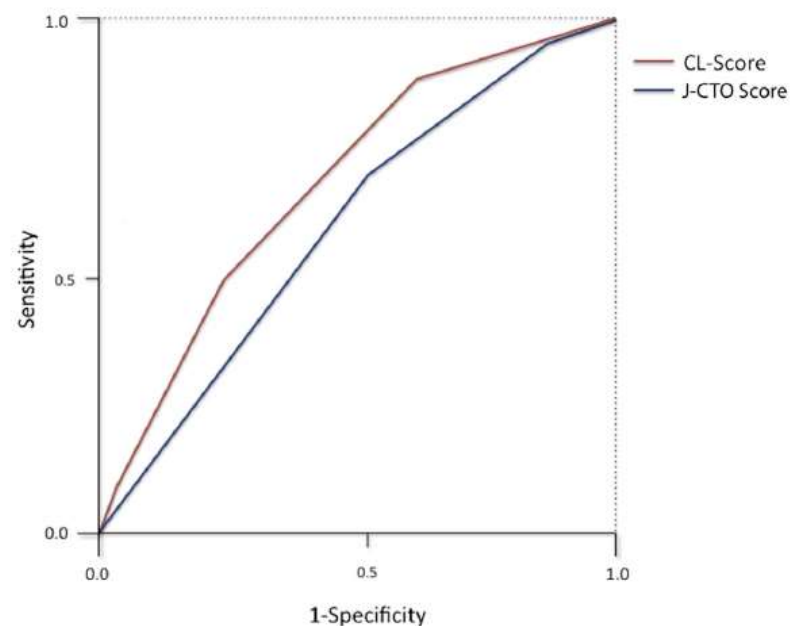
Giuseppe Alessandrino, MD, Bernard Chevalier, MD, Thierry Lefèvre, MD, Francesca Sanguinetti, MD, Philippe Garot, MD, Thier

FIGURE 1 Procedural Success Rate According to CL-Score Value in the Derivation and Validation Groups



RESULTS The study included in surgery +1.5 (odds ratio 1.6, 95% CI: 1.17-2.25), and blunt stents and ≥5 identified (derivation cohort 46.2%; p < 0.0

FIGURE 2 ROC Curve for Probability of Successful CTO-PCI According to CL-Score and J-CTO Score



Receiver-operating characteristic (ROC) analysis of the CL-score versus J-CTO score carried out in the validation cohort demonstrated the superior performance of the CL-score. The area under the curve was 0.68 for the CL-score and 0.60 for the J-CTO score. CL-score = clinical and lesion-related score; CTO-PCI = chronic total occlusion for percutaneous coronary intervention; J-CTO score = Japanese chronic total occlusion score.

Development and Validation of a Novel Scoring System for Predicting Technical Success of Chronic Total Occlusion Percutaneous Coronary Interventions



The PROGRESS CTO (Prospective Global Registry for the Study of Chronic Total Occlusion Intervention) Score

Georgios Christopoulos, MD,* David E. Kandzari, MD,† Robert W. Yeh, MD, MBA,‡ Farouc A. Jaffer, MD, PhD,‡ Dimitri Karpaliotis, MD,§ Michael R. Wyman, MD,|| Khaldoon Alaswad, MD,¶ William Lombardi, MD,# J. Aaron Grantham, MD,** Jeffrey Moses, MD,§ Georgios Christakopoulos, MD,* Muhammad Nauman J. Tarar, MD,* Bavana V. Rangan, BDS, MPH,* Nicholas Lembo, MD,† Santiago Garcia, MD,†† Daisha Cipher, PhD,‡‡ Craig A. Thompson, MD, MMSc,§§ Subhash Banerjee, MD,* Emmanouil S. Brilakis, MD, PhD*

J Am Coll Cardiol Intv 2016;9:1–9

FIGURE 1 Summary of the PROGRESS CTO Score

①

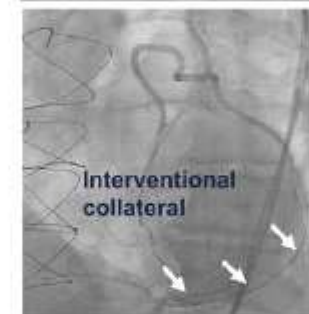
Proximal cap ambiguity (1 point)



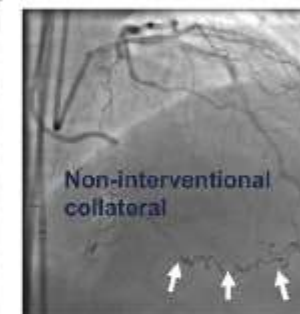
Poor cap visualization or absence of clearly tapered stump

②

Absence of “interventional” collaterals (1 point)



Interventional collateral



Non-interventional collateral

③

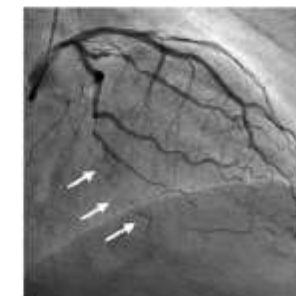
Moderate/severe tortuosity (1 point)



2 bends >70 degrees or 1 bend >90 degrees

④

Circumflex CTO (1 point)

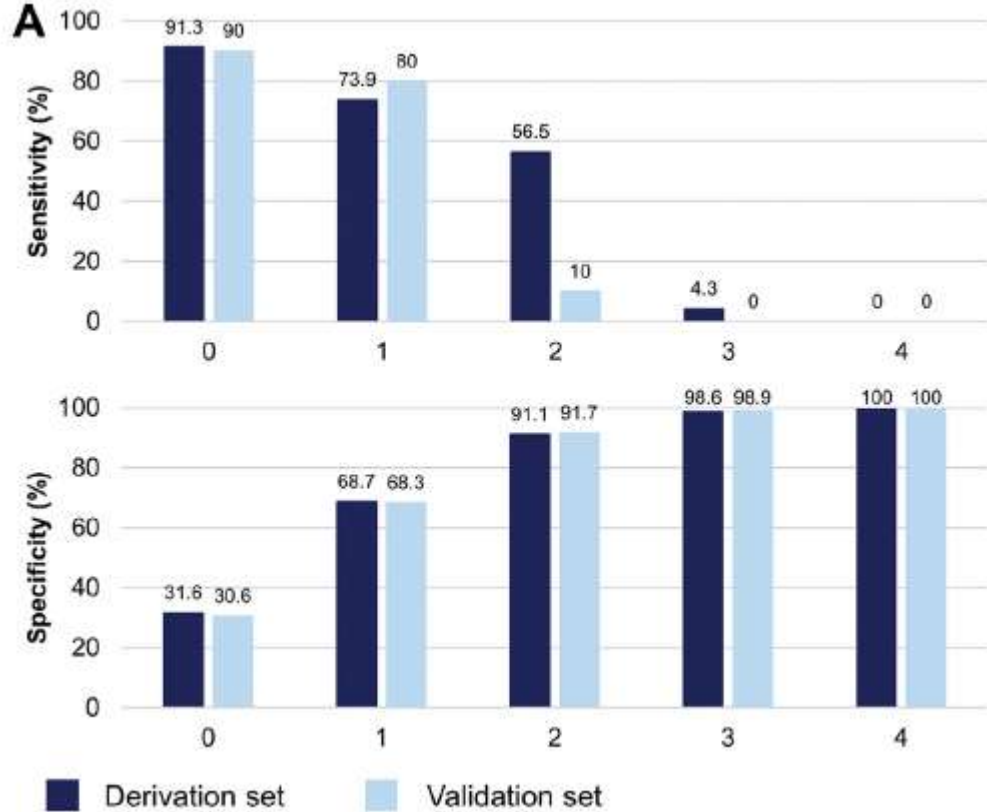


Development and Validation of a Novel Scoring System for Predicting Technical Success of Chronic Total Occlusion Percutaneous Coronary Interventions



The PROGRESS CTO (Prospective Global Registry for the Study of Chronic Total Occlusion Intervention) Score

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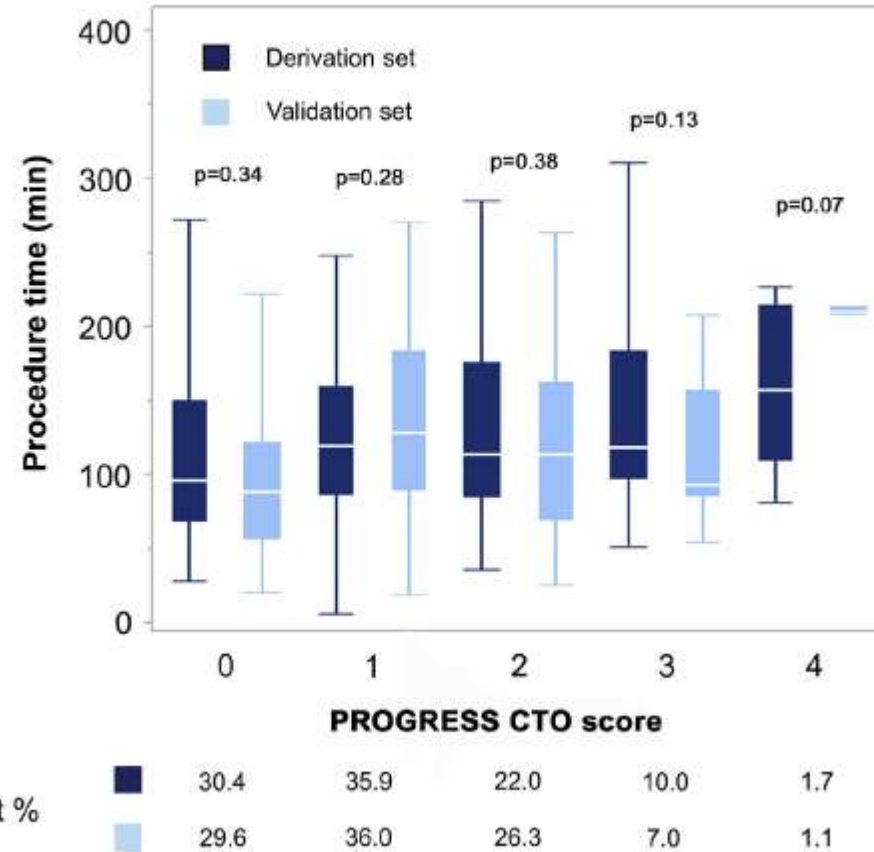


9:1-9

FIGURE 1 Summary of the PROGRESS CTO Score



FIGURE 4 Box Plot of Total Procedure Time in Each PROGRESS CTO Score Stratum in the Derivation and Validation Sets



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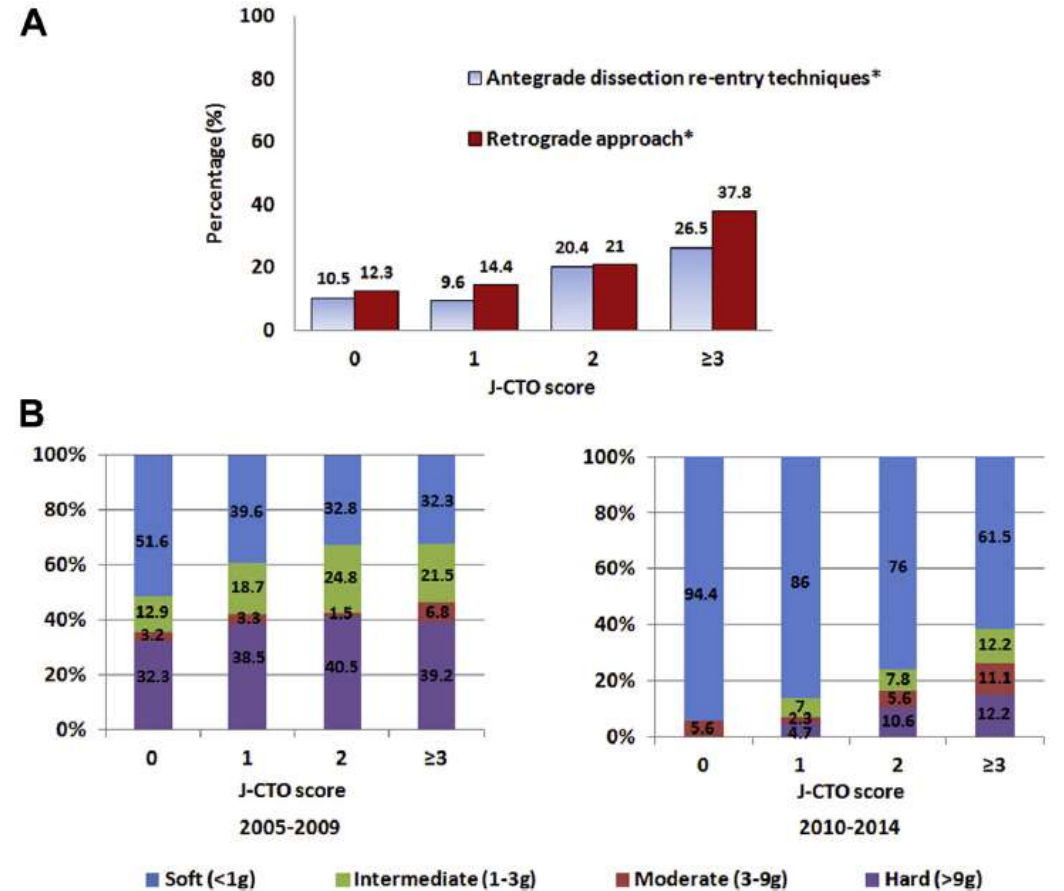
Percutaneous Coronary Revascularization for Chronic Total Occlusions

A Novel Predictive Score of Technical Failure Using Advanced Technologies

Alfredo R. Galassi, MD,^a Marouane Boukhris, MD,^{a,b} Salvatore Azzarelli, MD,^a Marine Castaing, MSc,^a Francesco Marzà, MD,^a Salvatore D. Tomasello, MD^a

J Am Coll Cardiol Intv 2016;9:911–22

FIGURE 3 Recanalization Techniques and Guidewires



Percutaneous Coronary Revascularization for Chronic Total Occlusions

A Novel Predictive Score of Technical Failure Using Advanced Technologies

Alfredo R. Galassi, MD,^a Marouane Boukhris, MD,^{a,b} Salvatore Azzarelli, MD,^a Marine Castaing, MSc,^a

From **FIGURE 2** Impact of Japanese Multicenter CTO Registry Score on Technical Success and Procedural Details

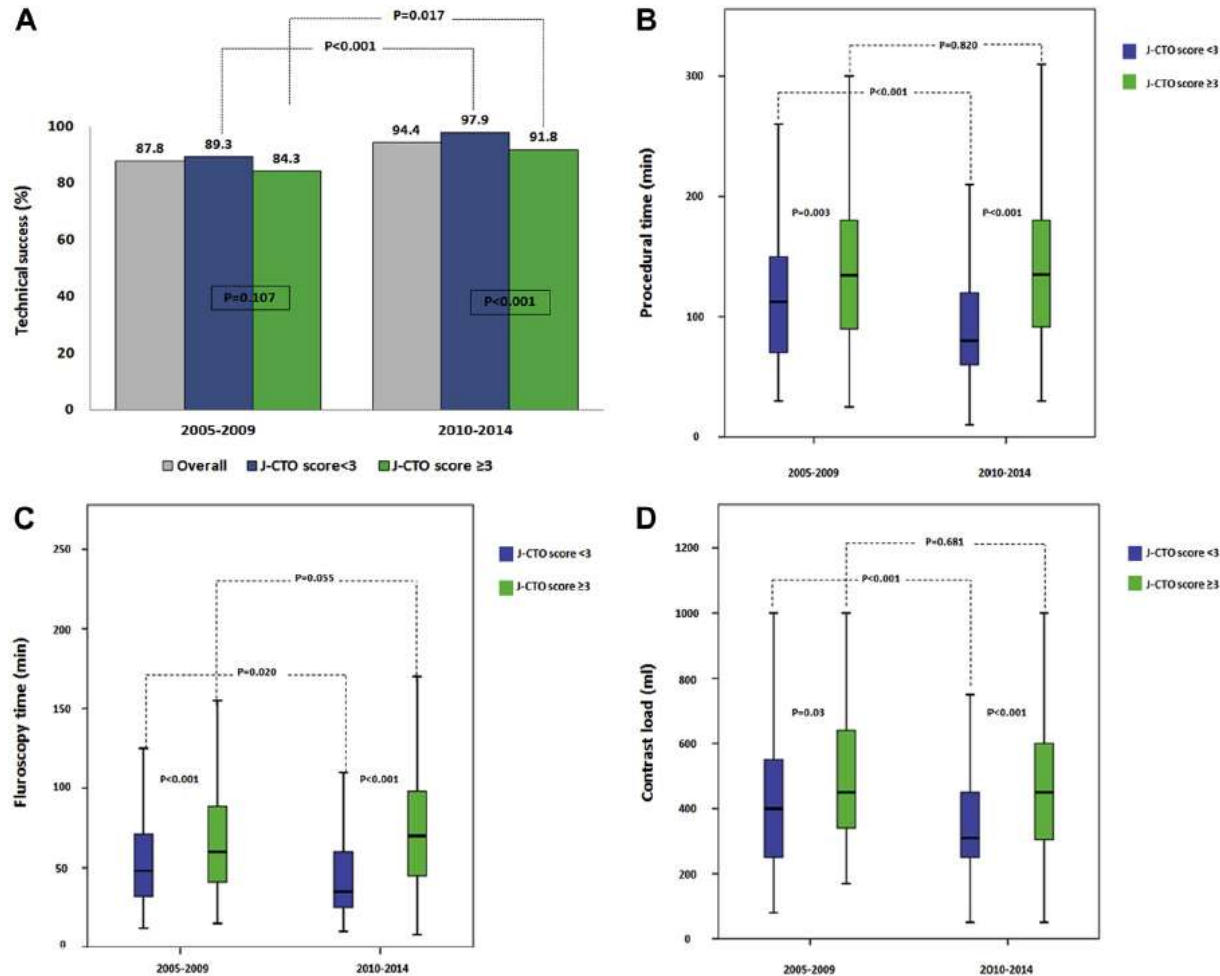
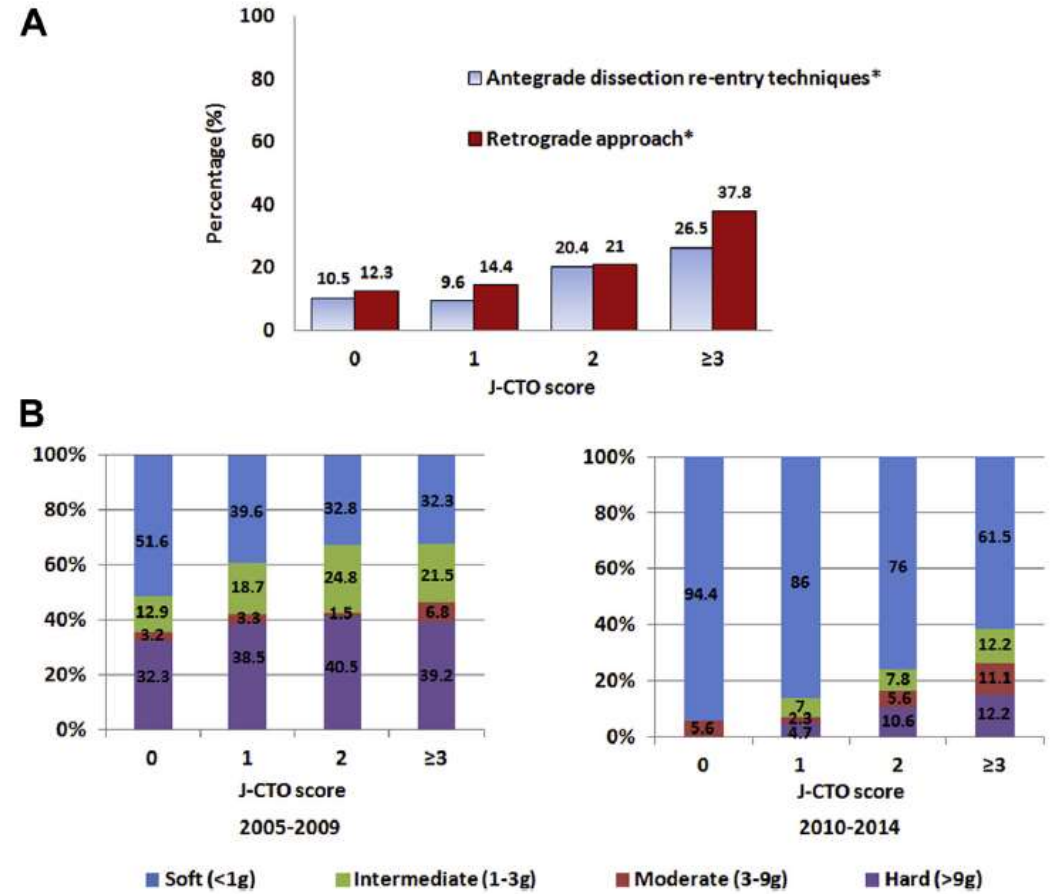


FIGURE 3 Recanalization Techniques and Guidewires



Percutaneous Coronary Revascularization for Chronic Total Occlusions

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From **FIGURE 2** Impact of Japanese Multicenter CTO Registry Score on Technical Success and Procedural Details

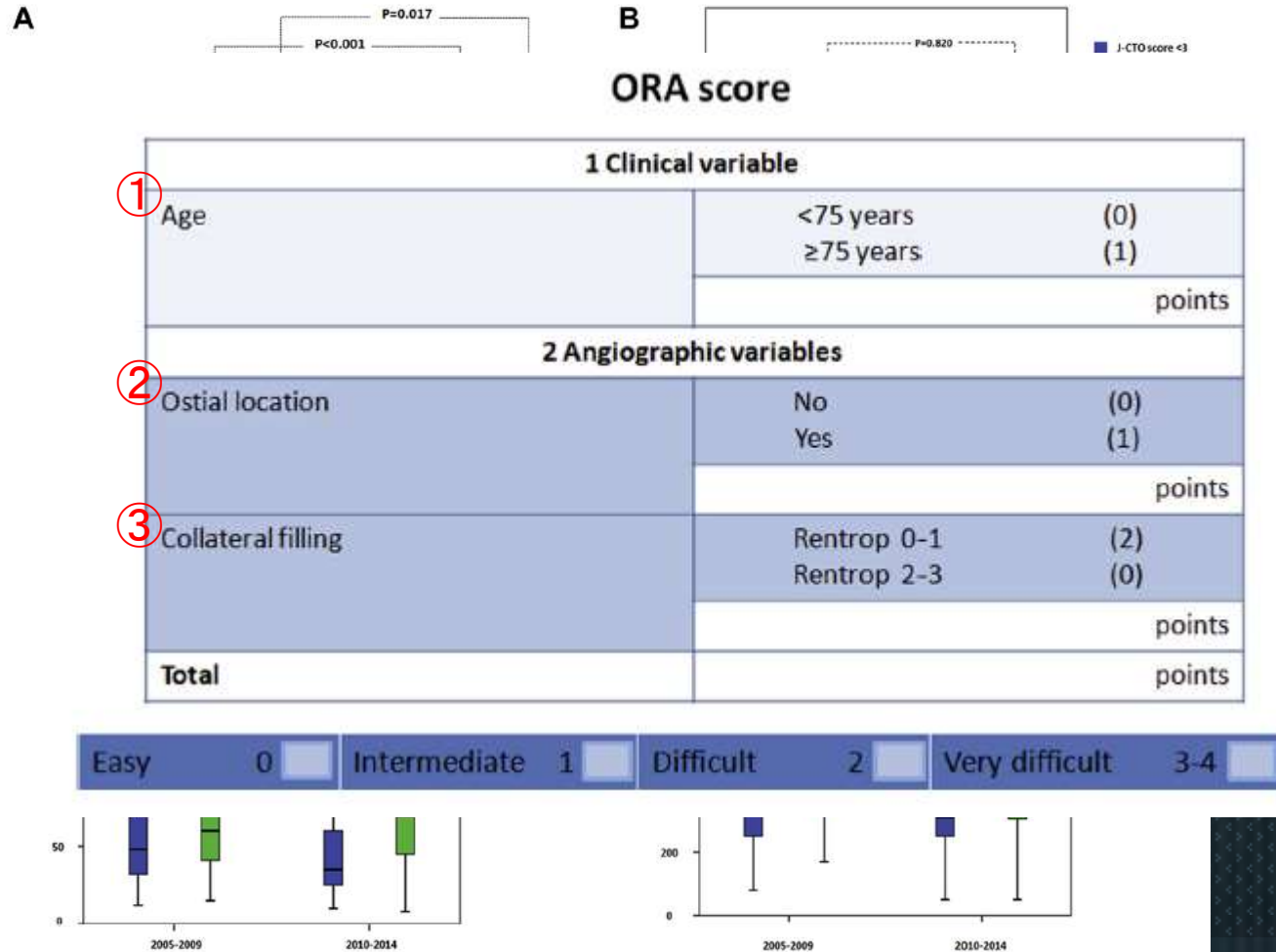
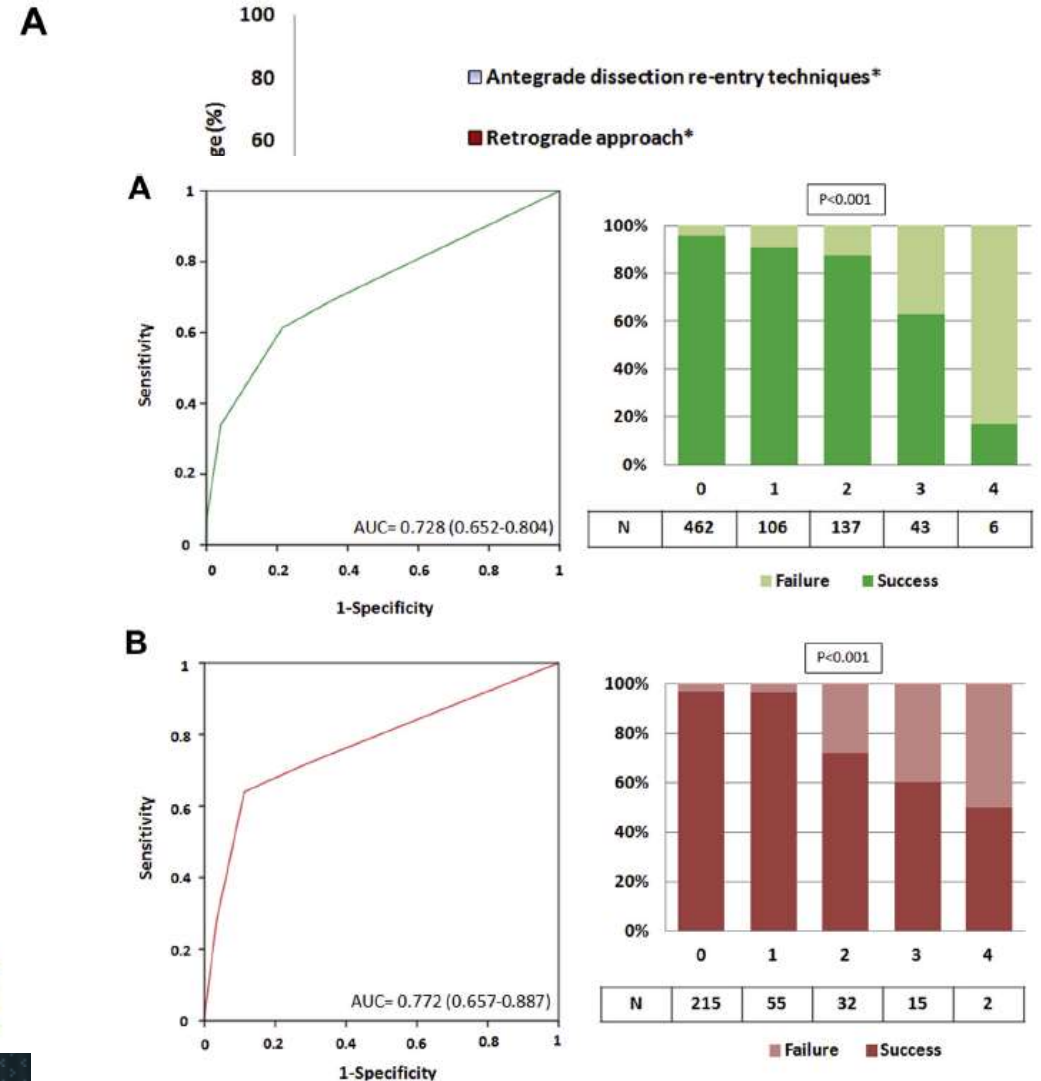


FIGURE 3 Recanalization Techniques and Guidewires



Towards a Contemporary, Comprehensive Scoring System for Determining Technical Outcomes of Hybrid Percutaneous Chronic Total Occlusion Treatment: The RECHARGE Score

Joren Maeremans,^{1,2} MSc, James C. Spratt,³ MD, Paul Knaapen,⁴ MD, PhD, Simon Walsh,⁵ MD, Pierfrancesco Agostoni,^{6,7} MD, PhD, William Wilson,⁸ MBBS, Alexandre Avran,⁹ MD, Benjamin Faurie,¹⁰ MD, PhD, Erwan Bressollette,¹¹ MD, Peter Kayaert,¹² MD, Alan J. Bagnall,^{13,14} MD, PhD, Dave Smith,¹⁵ MD, Margaret B. McEntegart,¹⁶ MD, PhD, William H.T. Smith,¹⁷ MD, BCHIR, PhD, FRCP, Paul Kelly,¹⁸ MD, John Irving,¹⁹ MD, Elliot J. Smith,²⁰ MD, FRCP, Julian W. Strange,²¹ MD, and Jo Dens,^{1,2*} MD, PhD

Catheter Cardiovasc Interv. 2018;91:192–202

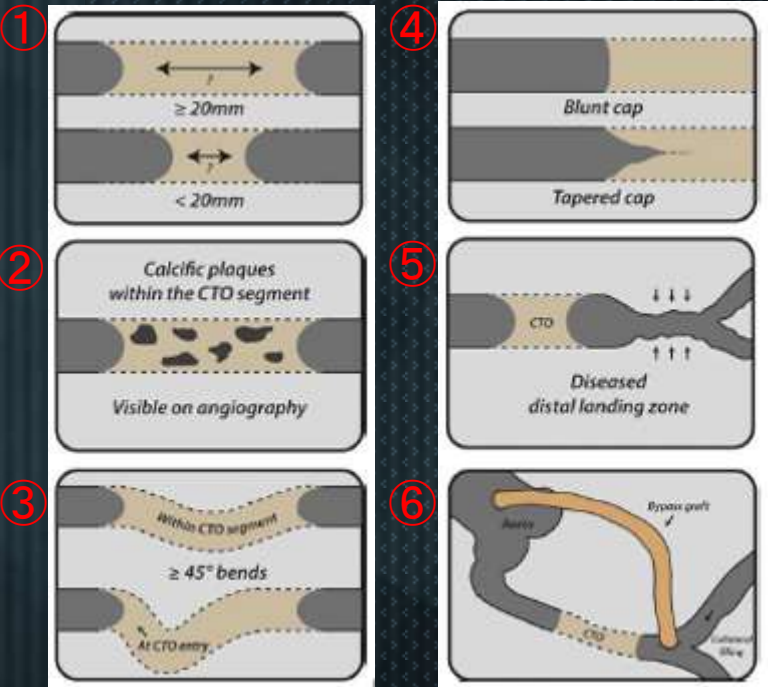
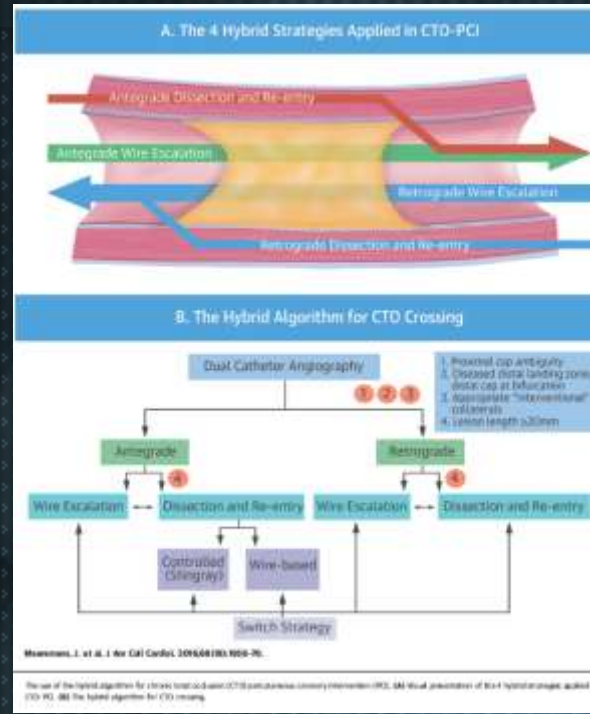
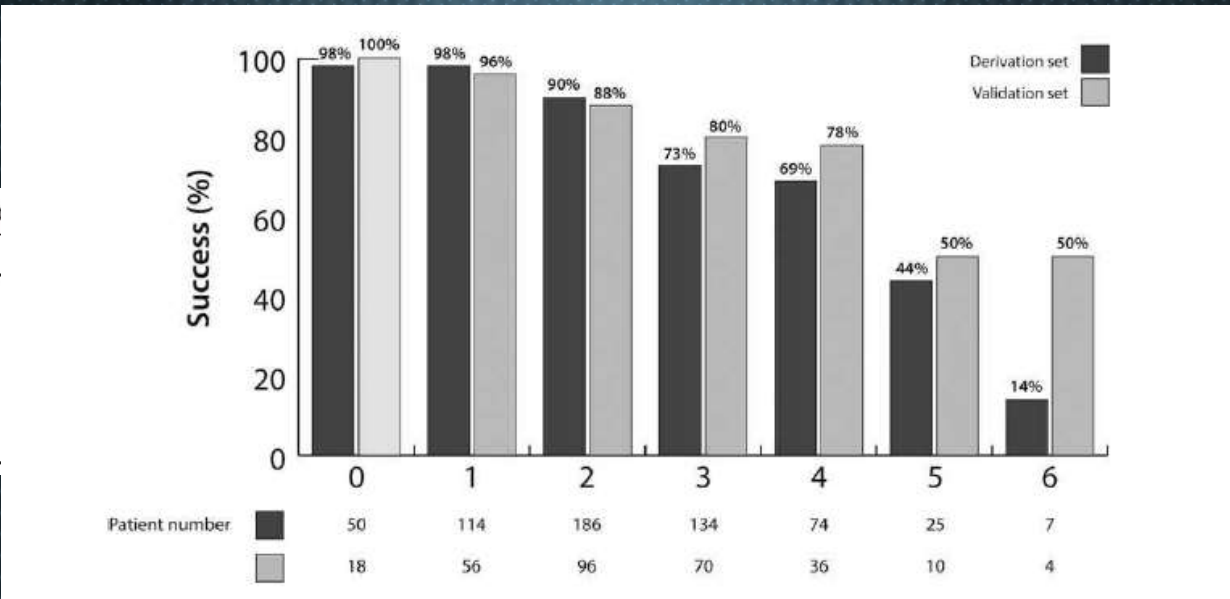


TABLE III. Multivariate Model

- Previous CABG on TV
- Blunt stump
- Calcification
- Tortuosity $\ge 45^\circ$
- Lesion length $\ge 20\text{ mm}$
- Diseased distal landing zone



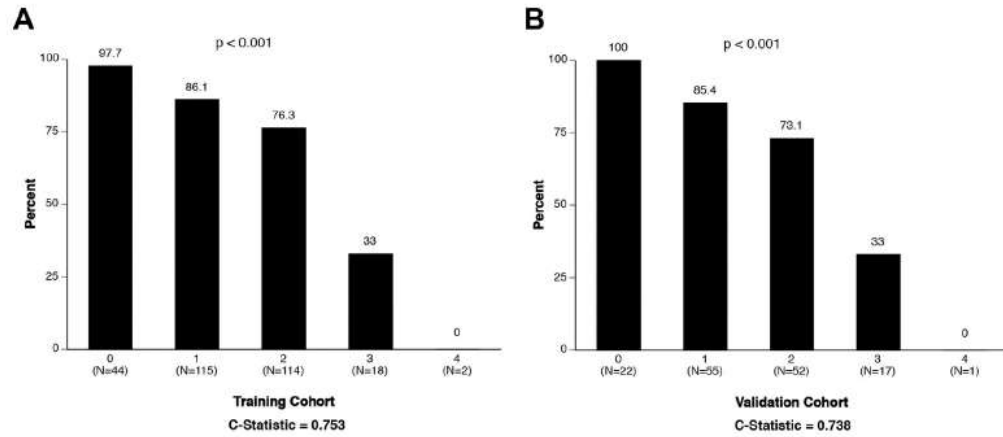
Predictors of Successful Hybrid-Approach Chronic Total Coronary Artery Occlusion Stenting



An Improved Model With Novel Correlates

Stephen G. Ellis, MD.^a M. Nicholas Burke, MD.^b M. Bilal Murad, MD.^c John I. Graham, MD.^d Ramv. Badawi, MD.^e Catelin Toma for the CAPS

Basic Model: Technical Success



Extended Model: Technical Success

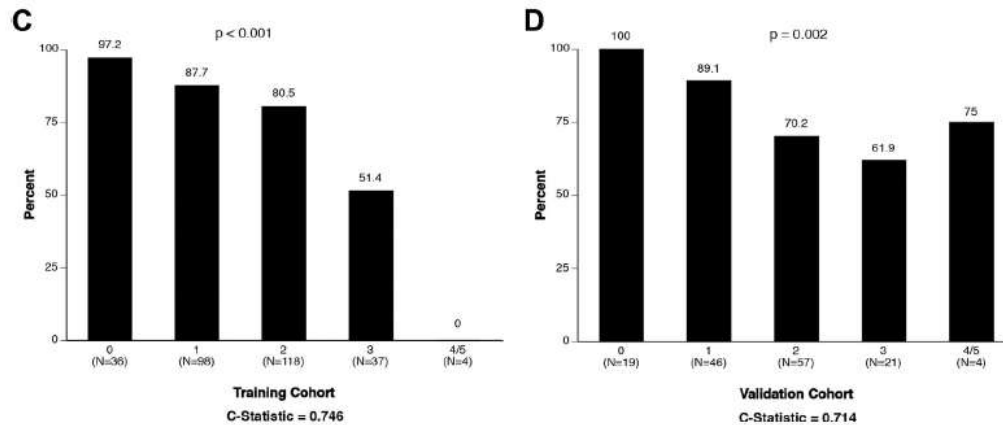
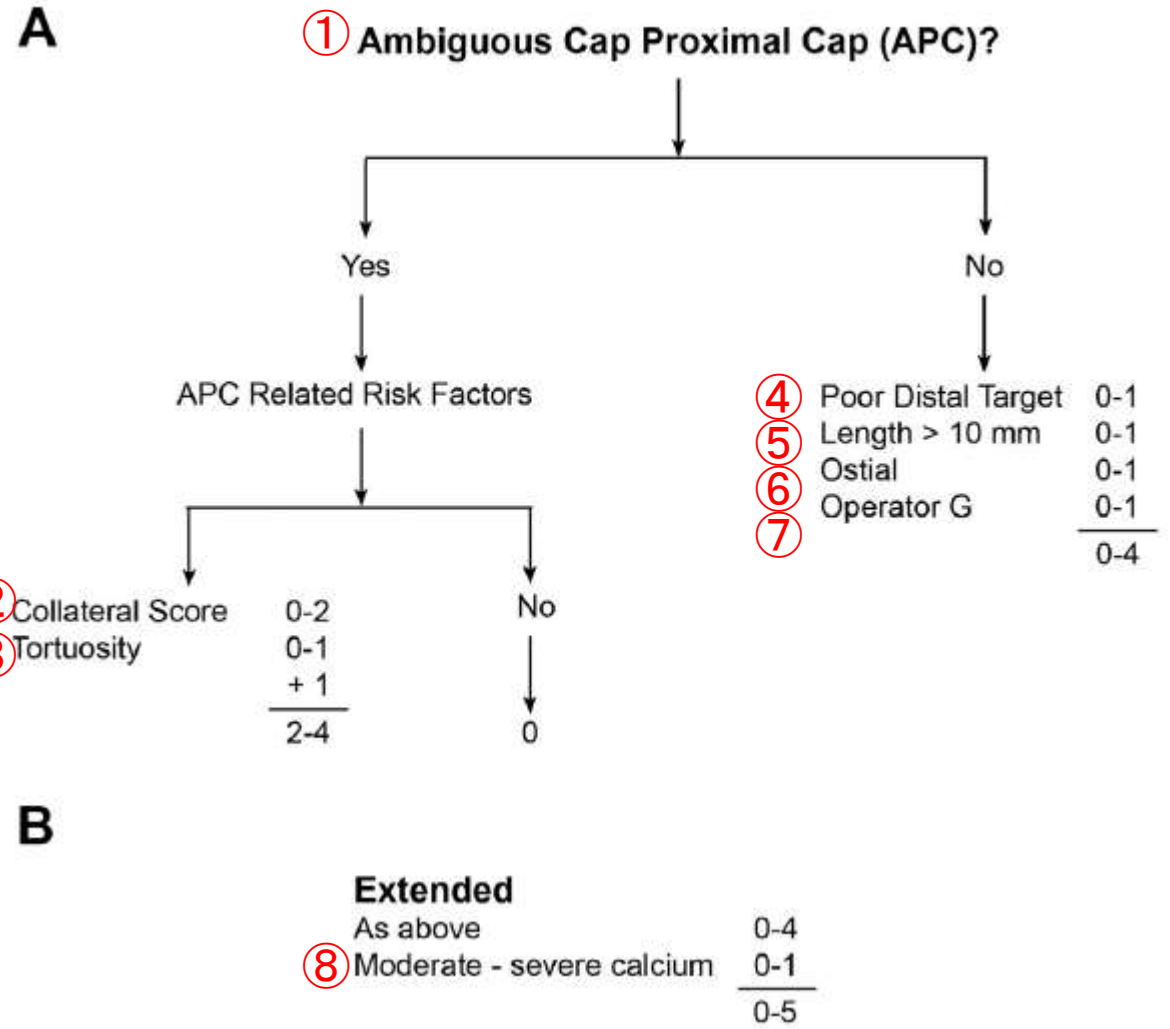


FIGURE 5 Proposed Basic Scoring System



Chronic Total Occlusion Percutaneous Coronary Intervention: Evidence and Controversies

Peter Tajti, MD; Emmanouil S. Brilakis, MD, PhD

J Am Heart Assoc. 2018;7:e006732

Score Variables	J-CTO Score ³⁴	CL Score ³⁴	PROGRESS-CTO Score ³⁸	ORA Score ³⁷	RECHARGE Score ³⁹	Ellis Score ³⁵
No. of cases	494	1657	781	1073	1253	456
End point	Guidewire crossing <30 min	Technical success	Technical success	Technical success	Technical success	Technical success
Age, y	2/6	-	-	+ (≥75)	+ (>65)	-
Prior CABG	2/6	-	+	-	+	-
Prior failure	1/6	+	-	-	-	-
Proximal cap	6/6	+ (Blunt)	+ (Blunt)	+ (Ambiguous)	+ (Ostial)	+ (Ambiguous, ostial)
Tortuosity	4/6	+ (>45° in lesion)	-	+ (Moderate,* proximal)	-	+
Calcification	4/6	+	+ (Severe)	-	-	+
Lesion length	4/6	+ (≥20 mm)	+ (≥20 mm)	-	-	+
Target vessel	2/6	-	+ (Non-LAD)	+ (LCX)	-	-
Collateral quality	3/6	-	-	+ (Interventional)	+ (Rentrop <2)	-
Other	-	-	Prior myocardial infarction	-	-	BMI >30 kg/m ² , nonproximal location
						Operator experience

Summary

- **Study population and inclusion criteria of clinical studies are strongly associated with the results of scoring systems.**
- **Parameters in each scoring system are acceptable and understandable to predict procedural success. However, they have not been still perfect because the strategy in CTO PCI has dramatically changed over the years with growing expertise and procedural volume.**
- **For beginners, CTO scores may be effective for scheduling procedure and preventing complication.**
- **Dr. Katoh said he needed more than 200 parameters to predict the procedural success...**

CTO Club

The 19th Seminar of Angioplasty of Chronic Total Occlusions

Dates June 15 Fri. – 16 Sat., 2018

Venue WINC AICHI, Nagoya, Japan