

Multi Slice Computed Tomography Findings in More Than 800 Consecutive Patients for TAVR

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Objective

- To assess the incidental non-cardiological findings that can be discovered fortuitously by systematic MSCT performed pre-treatment.
- To compare the aortic valve measurement performed by the operator and the corelab and their improvement overtime.
- To define the route of access according to the dimension of the peripheral vessels.

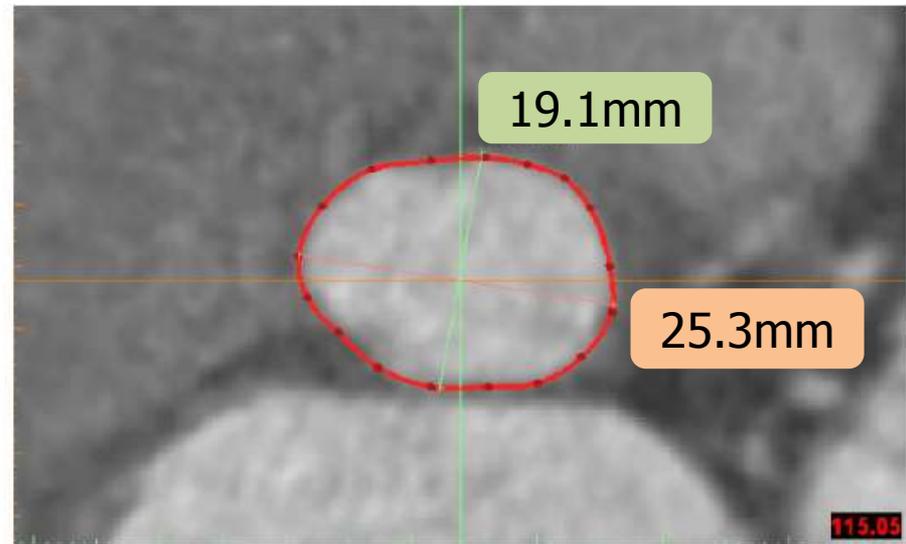
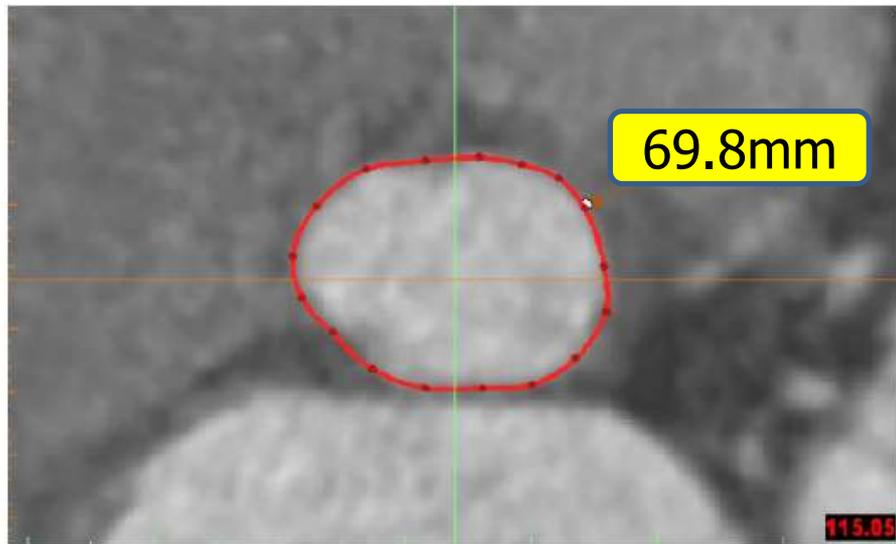
Study Population

- Population: 881 consecutive patients who were screened with Multi-Slice Computed Tomography (MSCT) in TAVR trials from Jan 2013 to July 2015.
- MSCT images were interpreted/analyzed by site and by imaging corelab in 846~881 depending on the type of parameter.

MSCT Acquisition

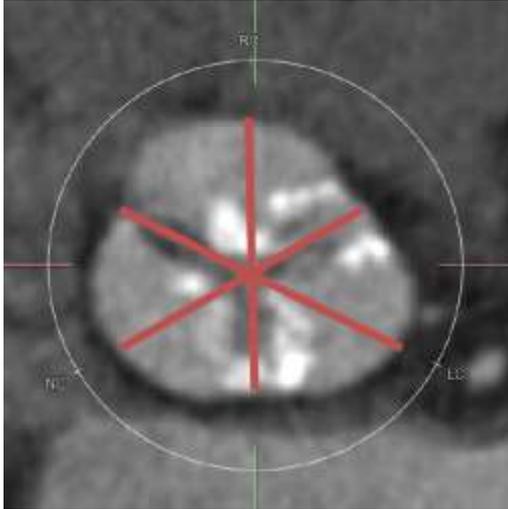
- ECG-gated contrast enhanced MSCT in a protocol similar to scan coronary MSCT.
- Non ECG-gated contrast enhanced scan was performed to evaluate abdominal aorta and peripheral access arteries(both iliacs, femorals and subclavian/axillary if applicable) for suitability for procedure.

Aortic annulus measurements (Systole)

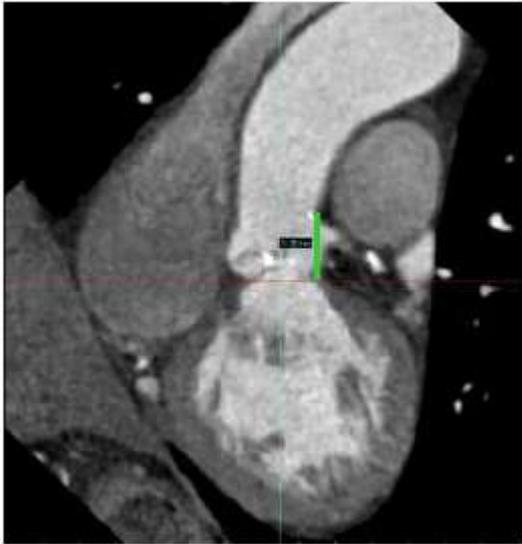


- (left) Example of perimeter measurement
- (right) Major and minor diameter measurements.

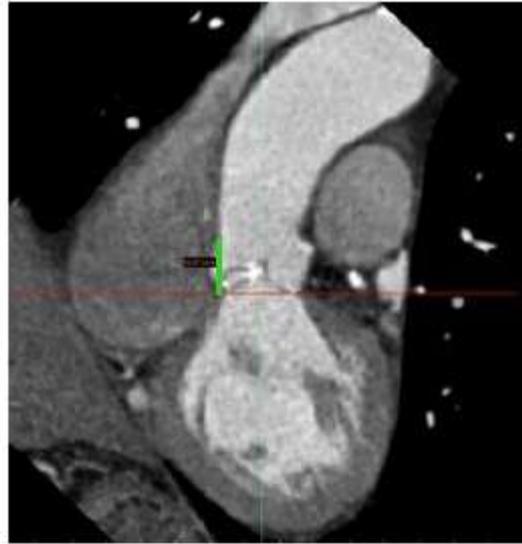
Aortic annulus measurements (Diastole)



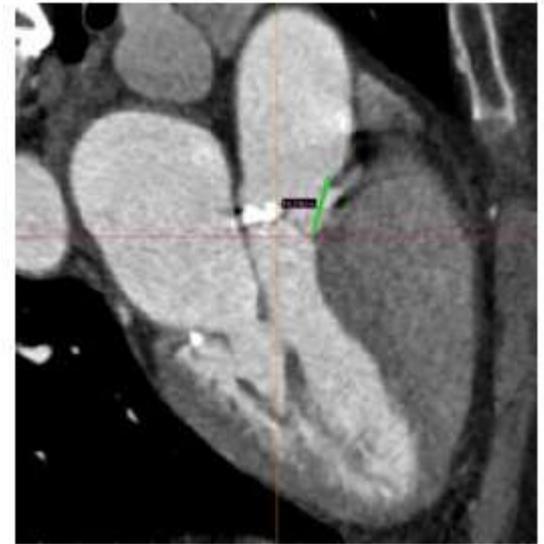
Example of sinus of Valsalva diameters.



Sinus of Valsalva Height
(Left)

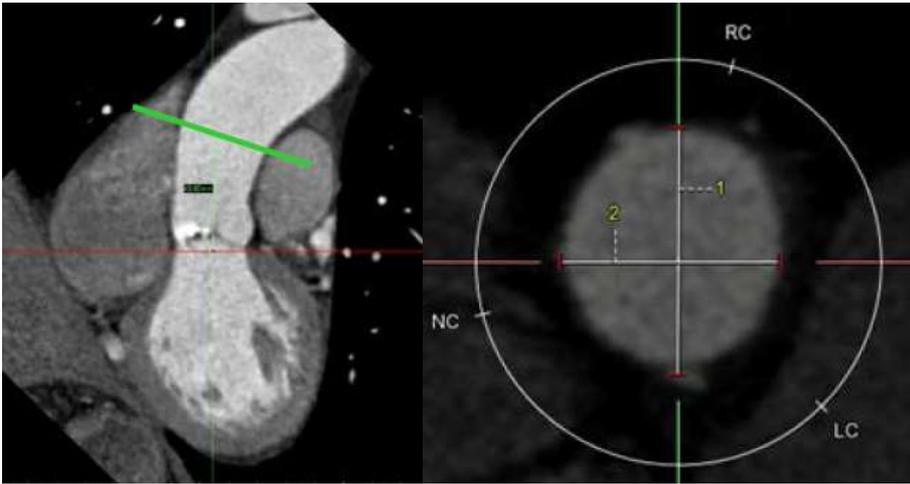


Sinus of Valsalva Heights
(Non)

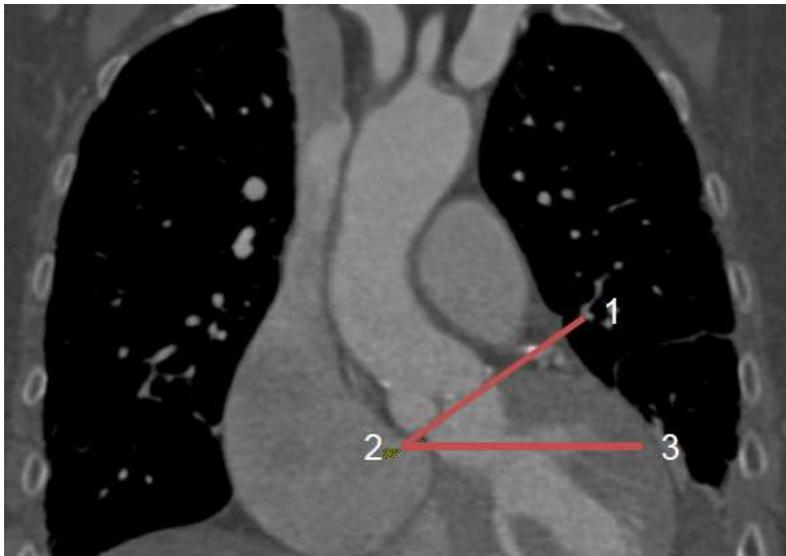


Sinus of Valsalva Heights
(Right)

Aortic annulus measurements (Diastole)

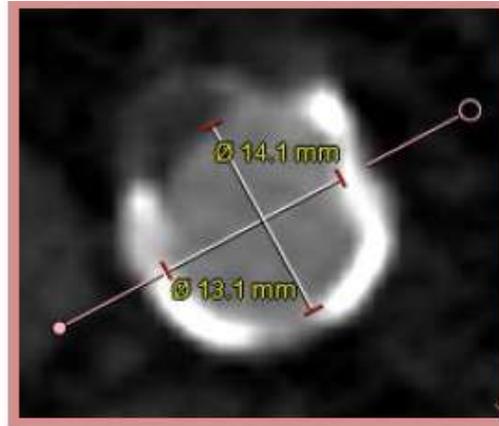
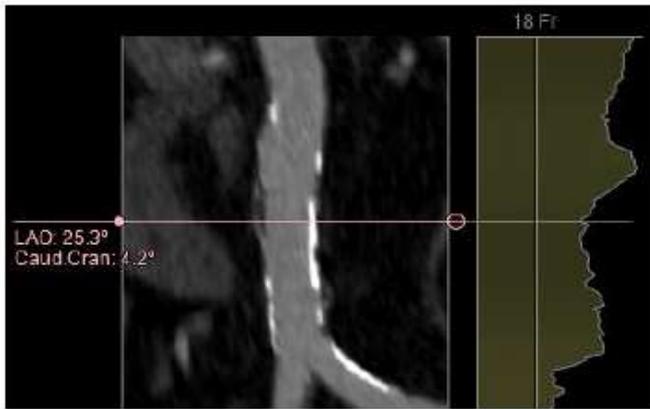


Oblique coronal with measurement of 40mm above the aortic annulus (left) and double-oblique reformatted to be perpendicular to that location (right).

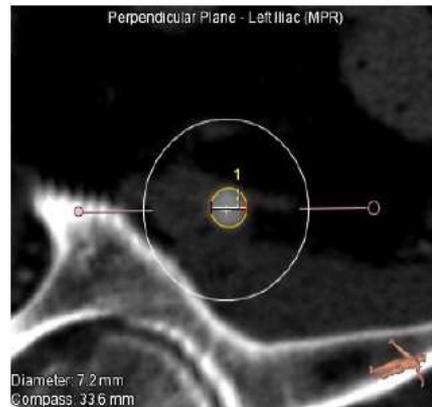
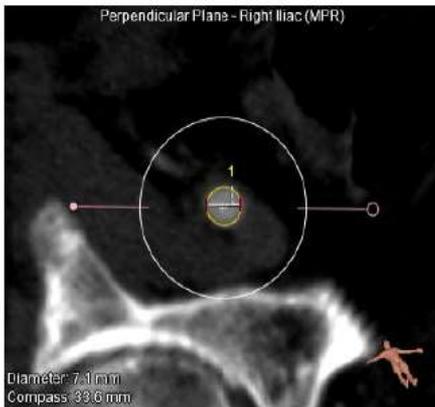


Aortic root angulation measurement on the standard coronal image.

Vessel measurement



Example of minimum abdominal aortic diameter. Stretched vessel (left), with the pink line at the location of the minimum luminal abdominal diameter. Orthogonal image (right), showing the minimum luminal diameter and the perpendicular diameter.



Example of the peripheral vessels and measurements for the right (left) and left (right) iliac arteries.

Baseline characteristics 1

variable	n=881
Age, years (mean±SD)	81.0±6.2
Female gender	42.5%
Height, cm (mean±SD)	169.0±11.0
Weight, kg (mean±SD)	80.6±18.8
Hypertension*	92.4%
Diabetes*	34.8%
Dialysis*	0.4%
Previous CABG*	17.8%
Previous PCI*	17.8%

* Data available approximately 550 patients

Baseline characteristics 2: Incremental risk

variable	n=881
Chronic lung disease*	34.7%
FEV<750	2.2%
FEV1 750-1000 cc	1.9%
Home (Supplemental) O2	2.6%
Nocturnal Bi-PAP	5.8%
Liver Disease Child A/B	0.3%
Infectious endocarditis*	0.2%
Immunosuppressive Therapy*	7.3%
Peripheral Vascular Disease*	31.1%
Cerebrovascular disease*	16.8%

* Data available approximately 550 patients

Baseline characteristics 3: Incremental risk and risk scores

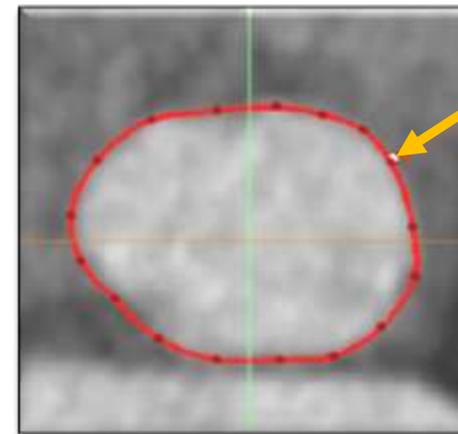
variable	n=881
LV Ejection Fraction	60.0±10.9%
Severe Diastolic Dysfunction	1.9%
PH (Systolic Pressure 60-80 mmHg)	2.9%
Severe Aortic Calcification	11.4%
BNP ≥ 550 pg/mL	16.0%
NT proBNP ≥ 3200 pg/mL	15.6%
creatinine, mg/dl*	1.1±0.3
STS Risk of Mortality	4.4±1.6
EuroSCORE Logistic	9.7±9.1
EuroSCORE II	2.8±6.4
Syntax	2.0±5.7
Katz Index	6.0±0.7
5-Meter Gait Speed >6 seconds	49.7%

* Data available approximately 550 patients

CT measurements site vs. Corelab

n=881	Site	Corelab	P-value
Annulus mean diameter	24.58±2.28 <	24.90±2.26	<0.001
Major annulus diameter	27.22±2.72 <	27.48±2.64	<0.001
Minor annulus diameter	21.84±2.40 <	22.25±2.33	<0.001
Aortic Annulus perimeter	78.50±7.16 =	78.35±7.01	0.220
Aortic root angulation	46.80±8.57 <	48.04±8.08	<0.001
Max Ascending Aorta diameter	33.63±3.78 >	33.26±3.28	<0.001
Minimum Sinus of Valsalva width	30.85±3.91 =	30.94±3.29	0.352
Minimum Sinus of Valsalva height	19.72±3.69 <	20.95±2.96	<0.001

Bland Altman Plot of CT measurement Aortic Annulus Perimeter Site vs. Corelab



Mean difference 1.15

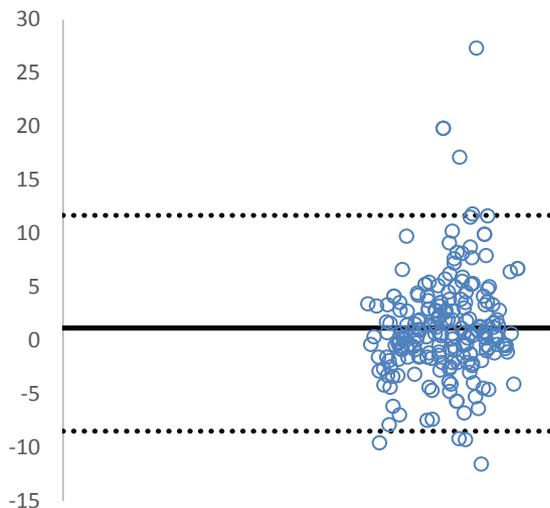
Limit of Agreement
-8.50 to 10.82

Mean difference -0.16

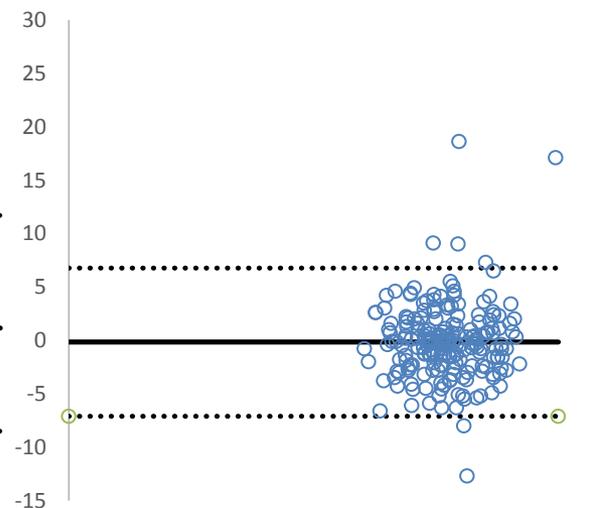
Limit of Agreement
-7.10 to 6.77

Mean difference -0.22

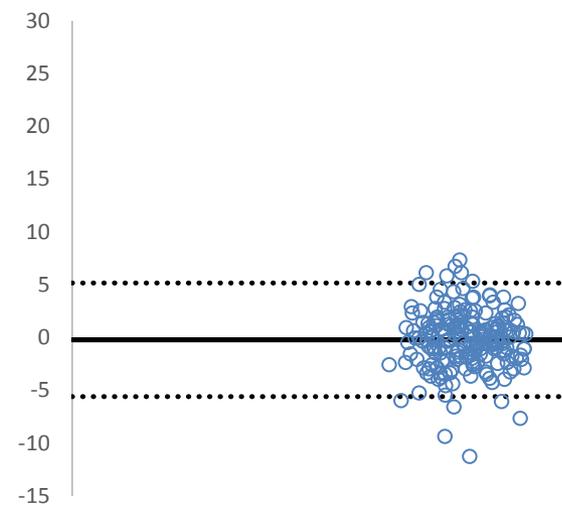
Limit of Agreement
-5.60 to 5.16



First wave(n=200)



Second wave(n=200)



Third wave(n=200)

Site measurements – Corelab measurements

CT measurements site vs. Corelab

n=881	Site (mm)	Corelab (mm)	P-value
Minimum Right Femoral artery	7.27±1.56 >	7.00±1.30	<0.001
Minimum Right Iliac artery	7.32±2.60 >	6.74±1.39	<0.001
Minimum Left Femoral artery	7.34±1.62 >	7.02±1.36	<0.001
Minimum Left Iliac artery	7.26±1.57 >	6.86±1.41	<0.001

The sheath to femoral artery ratio (SFAR) predicted major vascular complications and Prostar Failure

SAFR predicts major vascular complication

SFAR

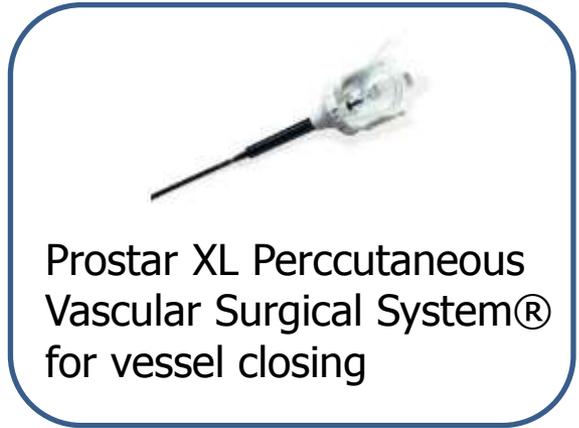
Variables	≥1.05 (n = 55)	<1.05 (n = 72)	p Value
Any vascular complication	23 (41.8%)	12 (16.7%)	<0.001
VARC Major	17 (30.9%)	5 (6.9%)	0.001
VARC Minor	6 (10.9%)	7 (9.7%)	0.827
Femoral artery complication	15 (27.3%)	9 (12.5%)	0.035
Iliac artery complication	11 (20.0%)	2 (2.8%)	0.002
In-hospital mortality	11 (20.0%)	5 (6.9%)	0.033
30-day mortality	10 (18.2%)	3 (4.2%)	0.016

JACC cardiovascular interventions 2011; Kentaro Hayashida, Marie-Claude Morice et al

Predictors of Prostar Failure

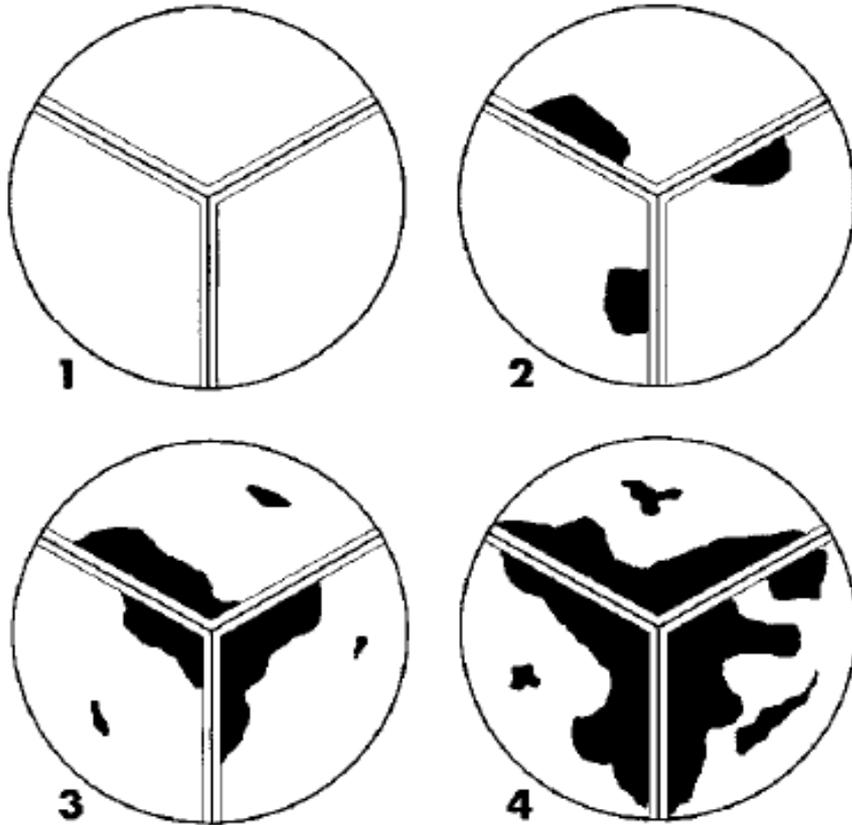
Univariate

Variables	Odds Ratio	95%CI	p Value
Early experience	3.66	1.04–13.89	0.047
SFAR	110.80	1.15–10,710.73	0.044



JACC cardiovascular interventions 2012; Kentaro Hayashida, Marie-Claude Morice et al

Classification of aortic valve calcification



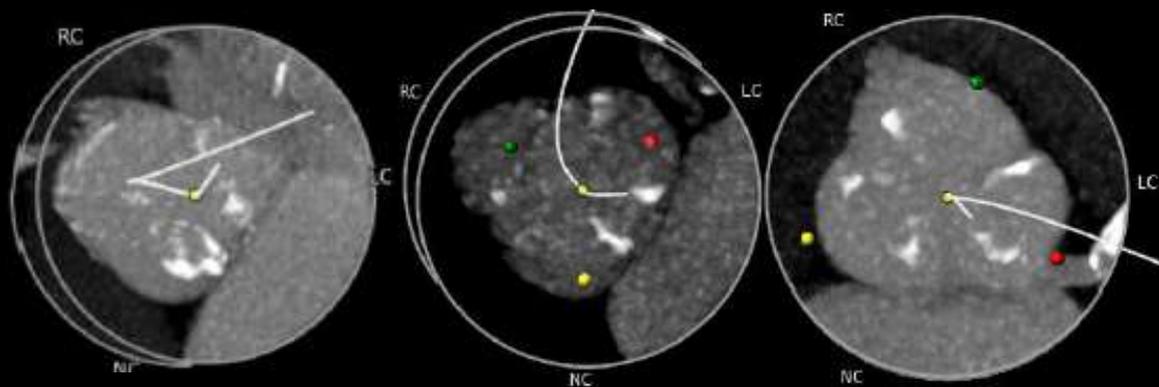
Grade 1: no calcification

Grade 2: mild calcification (small isolated spots of calcification)

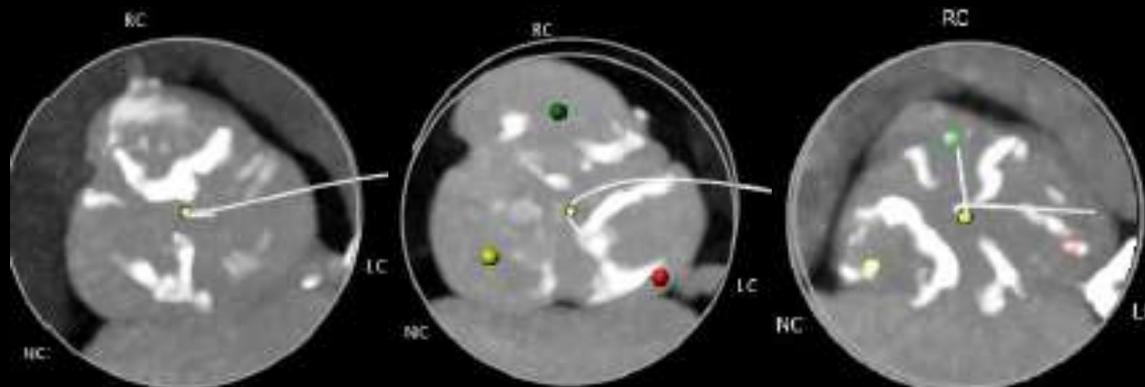
Grade 3: moderate calcification (multiple larger spots of calcification)

Grade 4: heavy calcification (extensive calcification of all aortic valve leaflets)

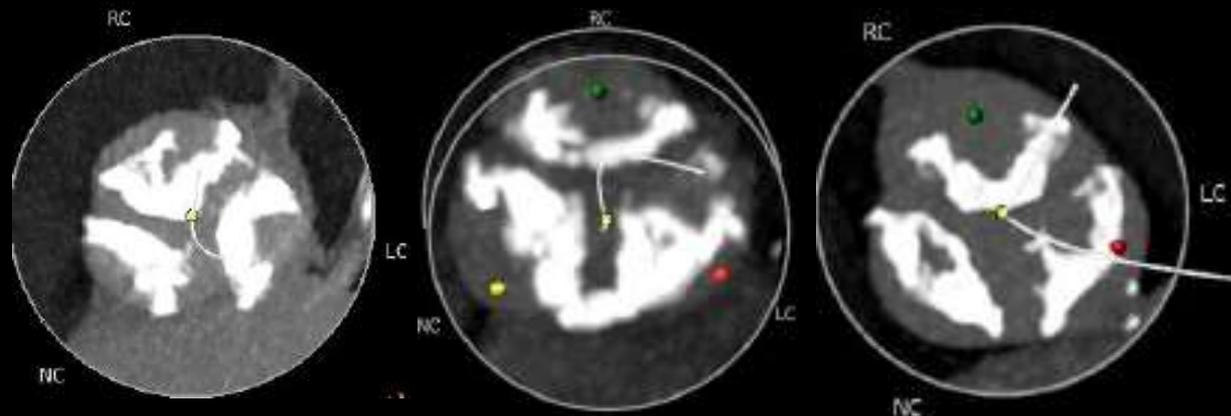
Grade 2



Grade 3



Grade 4

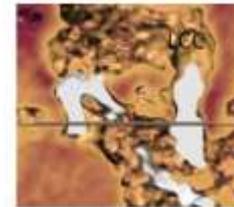
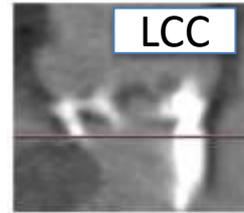
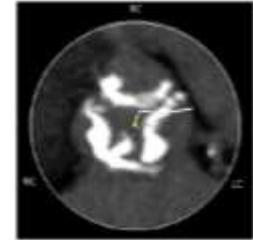
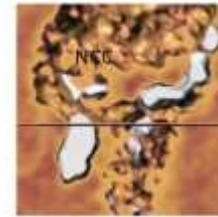
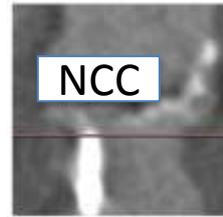
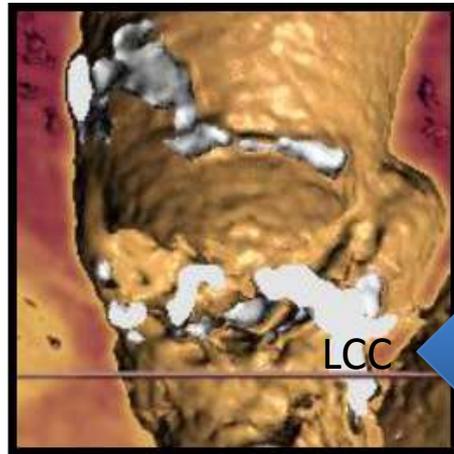


Degree and location of calcification

degree	1	2	3	4
n=881	0%	11%	51%	39%

locate	All leaflets	L+R	L+N	R+N
n=881	98%	0.3%	1.1%	0.7%

Aortic annulus and LV outflow tract calcification



	Isolated annulus calc. (%)	Annulus calc. extending into LVOT(%)	Total(%)
	2.5	16.1	18.6
Under LCC	1.2	6.4	7.6
Under NCC	0.3	4.5	4.8
Under RCC	0.5	0.9	1.4
Under 2 or 3 capsid	0.5	4.3	4.8

LVOT calcification and annulus rupture

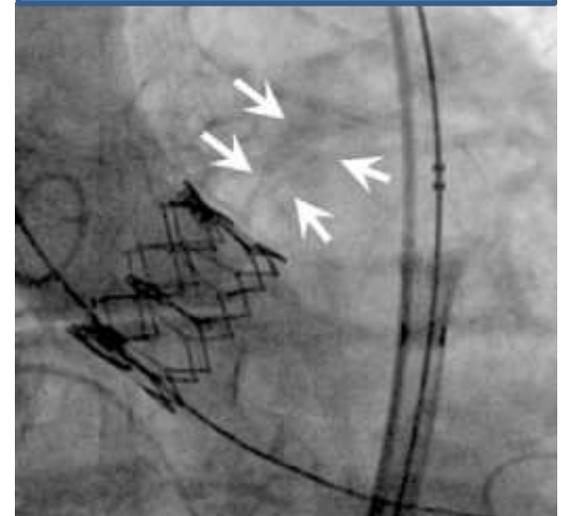
Pre-procedural CT scan showed a huge calcified nodule on the annulus



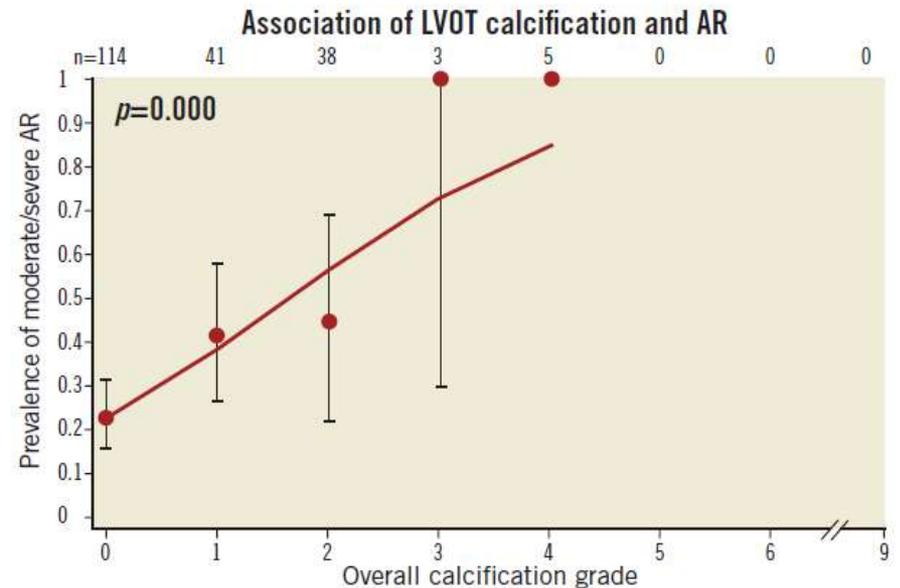
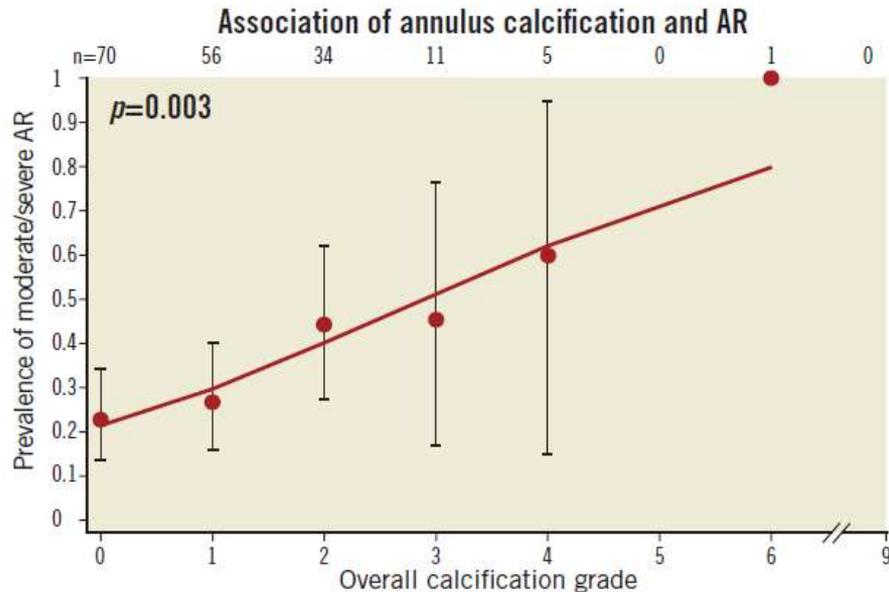
Post-procedural CT scan showed contrast leakage due to annulus rupture



Aortography showed contrast effusion from the aortic cusp



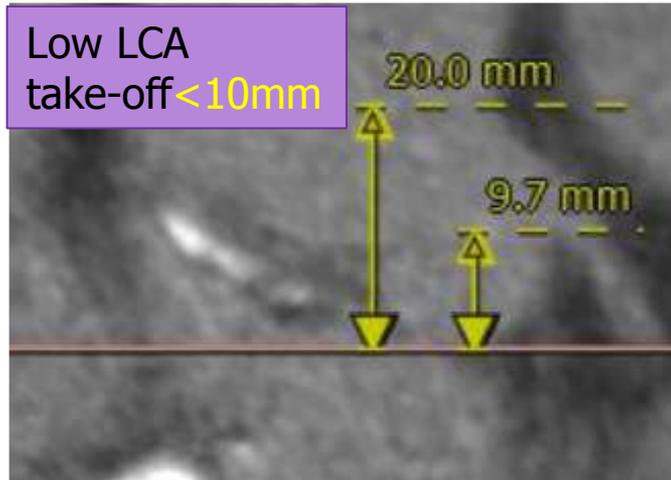
Annulus and LVOT calcification predict aortic regurgitation after TAVR



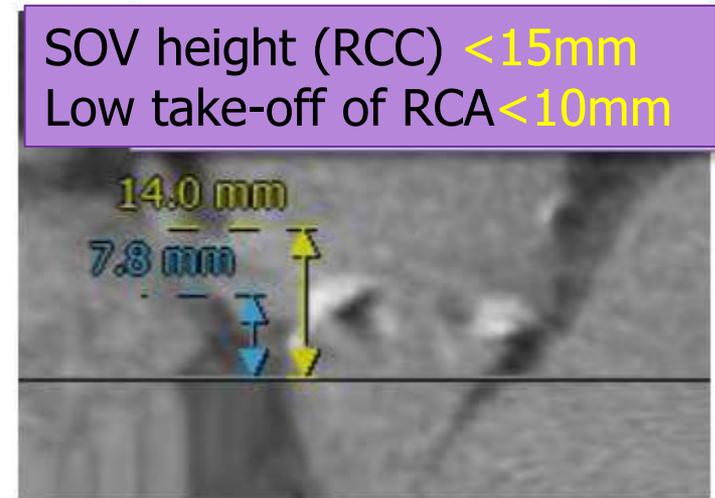
Grade 0	No calcification
Grade 1 (mild)	Small, non-protruding calcification
Grade 2 (moderate)	Protruding (>1 mm) or extensive (>50% of cusp sector) calcification
Grade 3 (severe)	Protruding (>1 mm) and extensive (>50% of cusp sector) calcification
LVOT: left ventricular outflow tract	

Coronary take-off and Sinus of Valsalva Height

Left Coronary Cusp



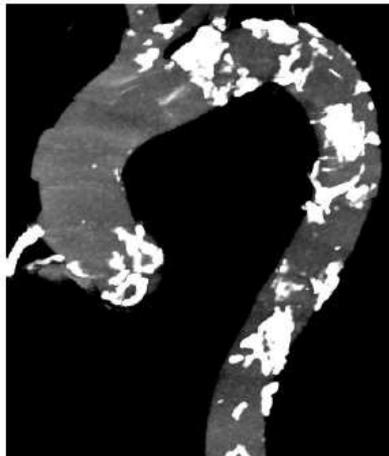
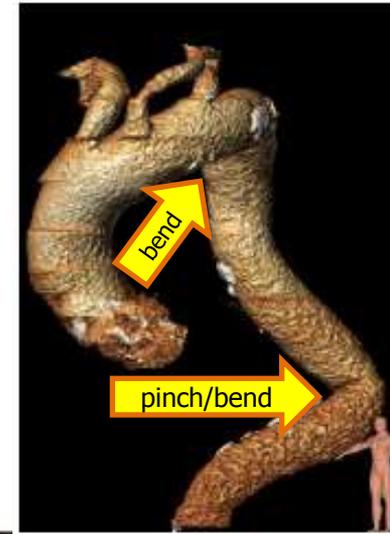
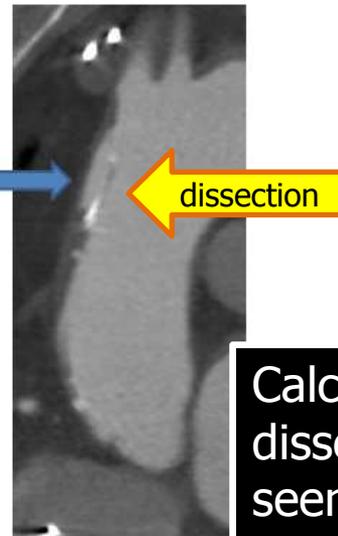
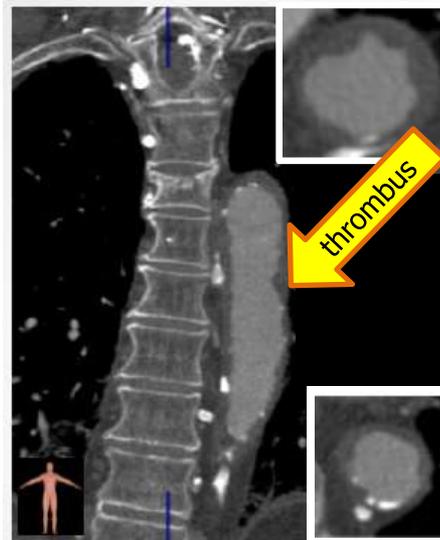
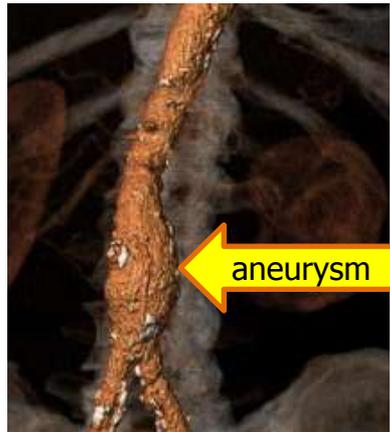
Right Coronary Cusp



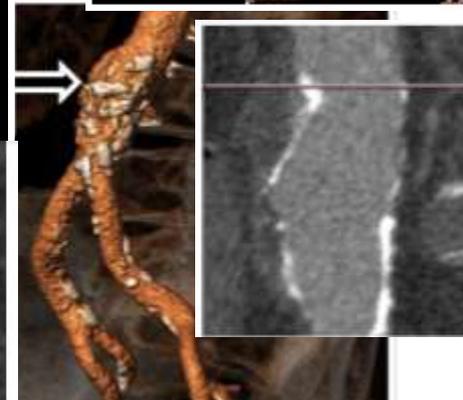
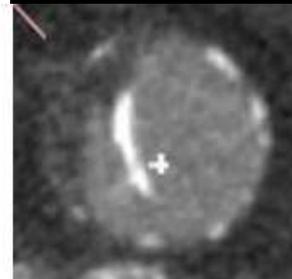
Take-off	%
Low take-off LCA	4.0
Low take-off RCA	0.8
Low SOV Height	1.2

Aortic root disease

Location	Calcification (%)	Aneurysm (%)	Plaque/ thrombus(%)	Dissection (%)	Tortuous/ bend(%)
Thoracic	89	1.1	0.7	0.6	3.4
Abdominal	98	6.1	5.2	1.2	

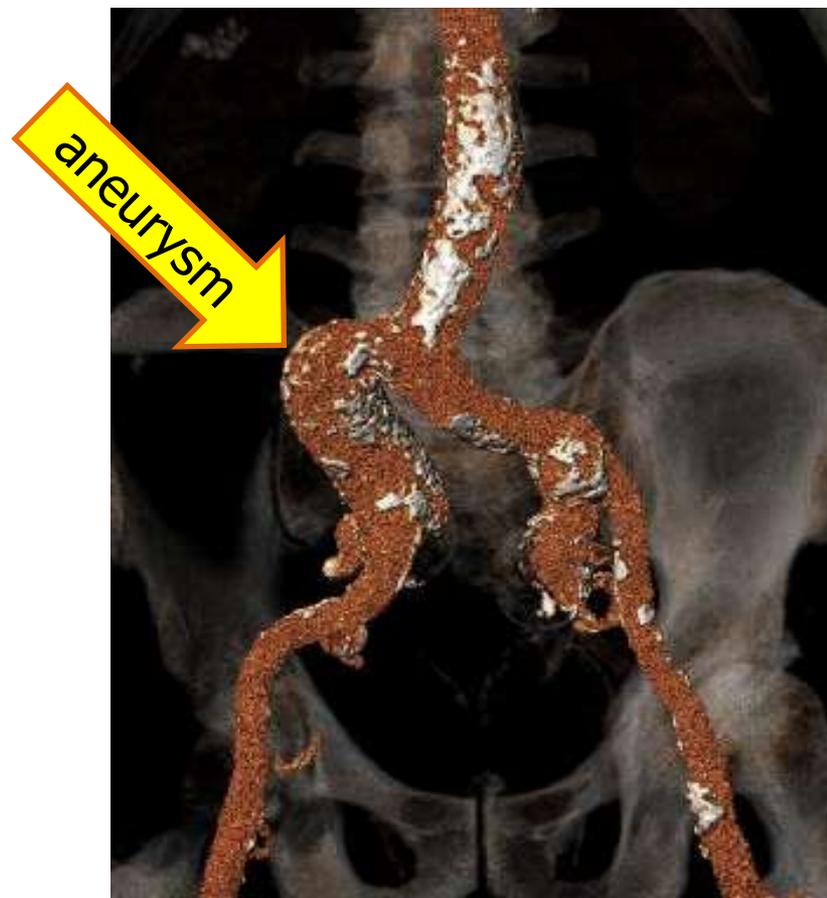
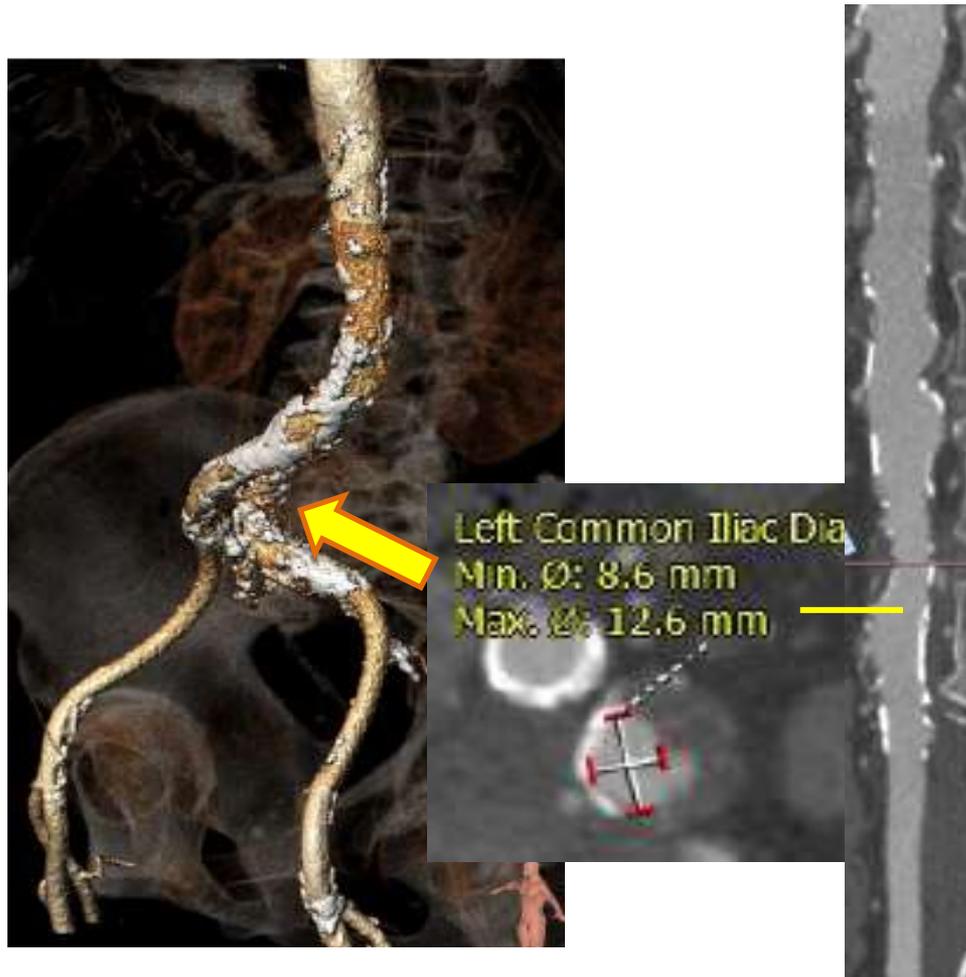


Calcified dissection seen in abdominal aorta



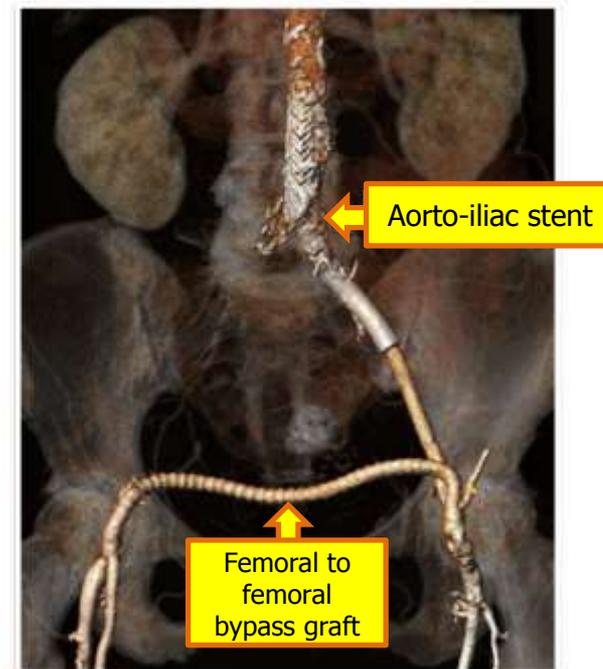
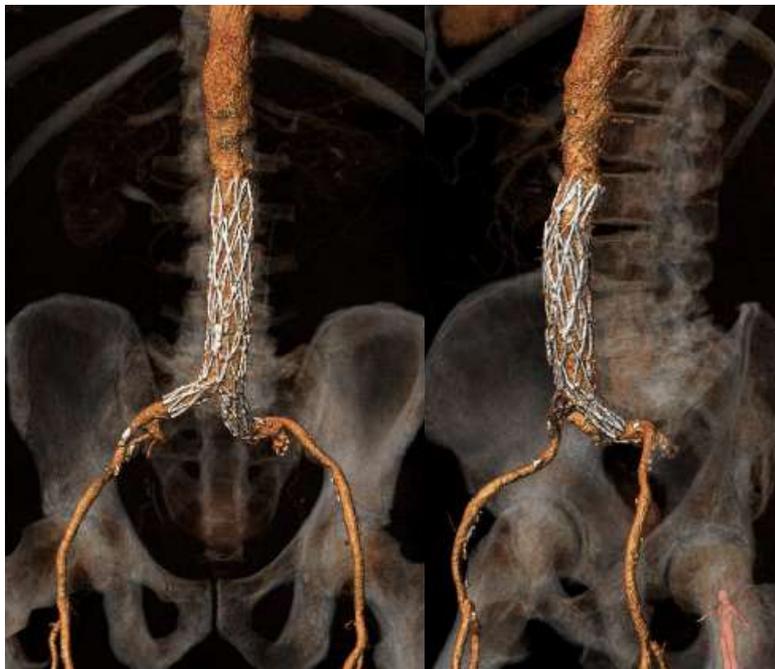
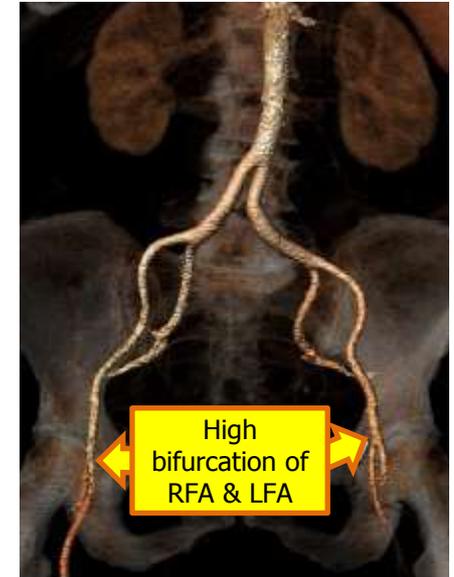
Access site related disease

	Calcification (%)	<6mm (%)	Tortuous/bend(%)	Plaque/thrombus(%)	Aneurysm (%)	Dissection (%)
Ilio-femoral artery	98	33	6.8	4.8	2.2	1.6



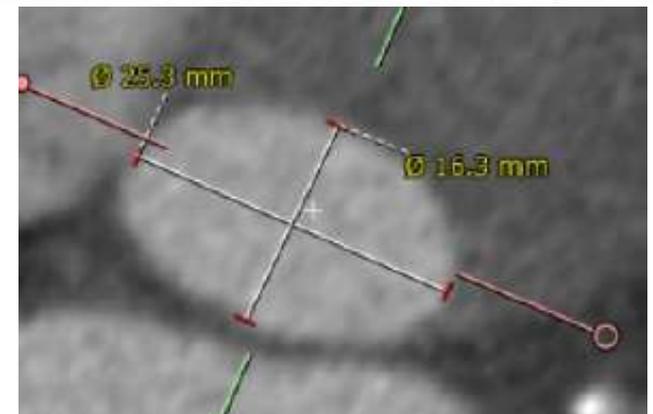
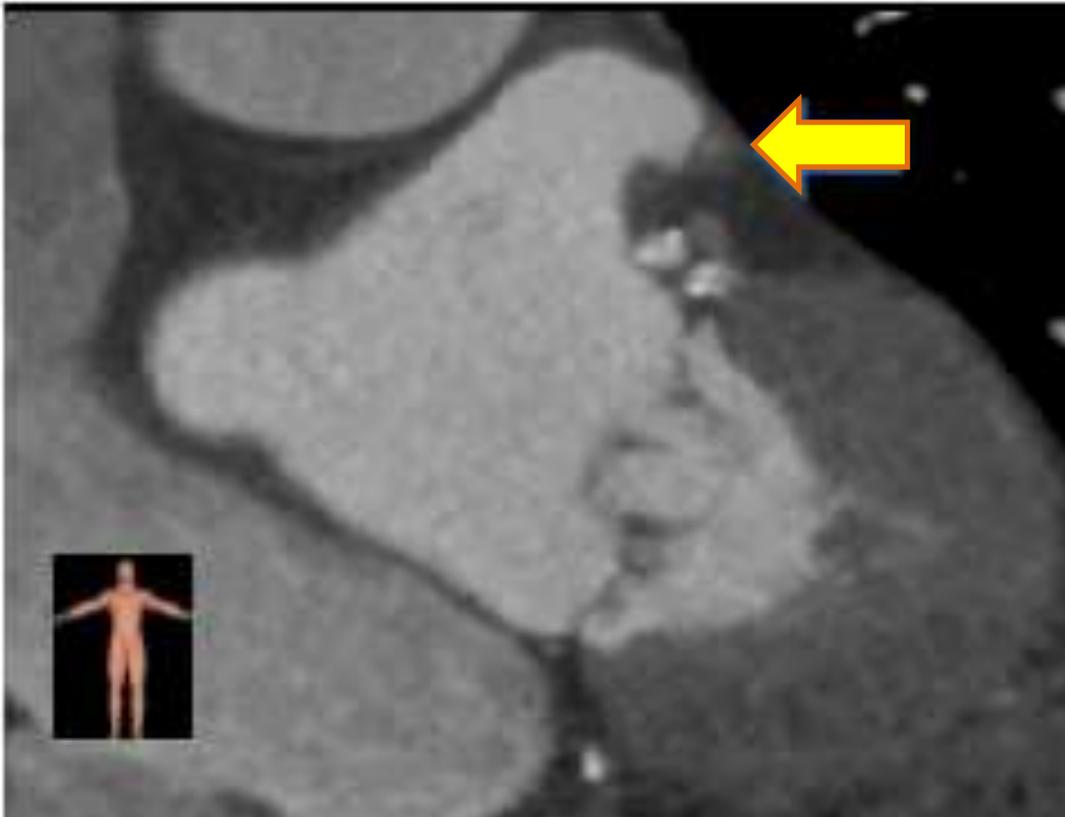
Access site related disease

Femoral access site	%
Lt or rt high bifurcated femoral artery	11.0
Aorto-iliac stent	1.0
Stent in iliac artery	0.2
Aorto-bifemoral bypass	0.2
Aorto-iliac stent and F-F bypass	0.1



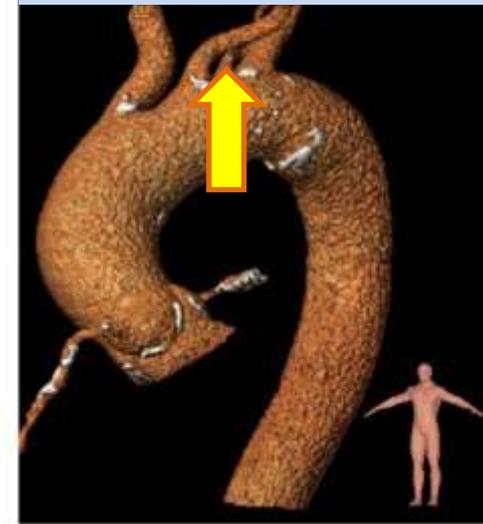
Cardiac findings

findings	%
Possible LAA thrombus	3.7
Eliptical LVOT	0.8



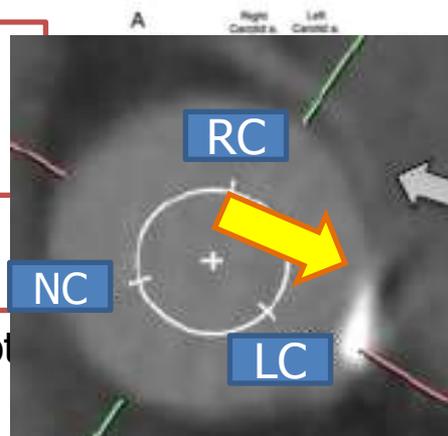
Anomalous vessel and etc

Anomalous vessel arises from the aortic arch

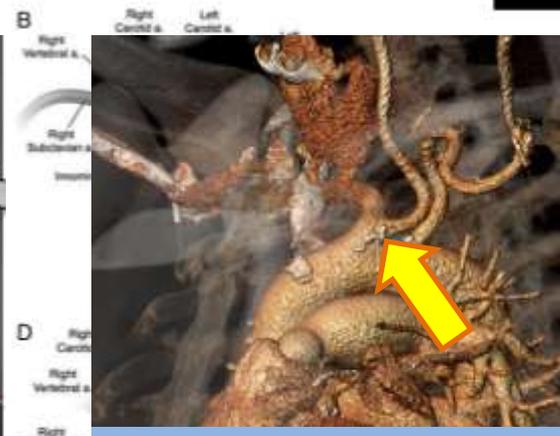


findings	%
Left common carotid and innominate artery share same origin	2.7
Anomalous vessel originating from aortic arch	0.1
Coarctation in distal arch	0.1
LCA originating from RCC	0.1
RCA originating from LCC	0.3
RCA originating from between RCC and NCC	0.1

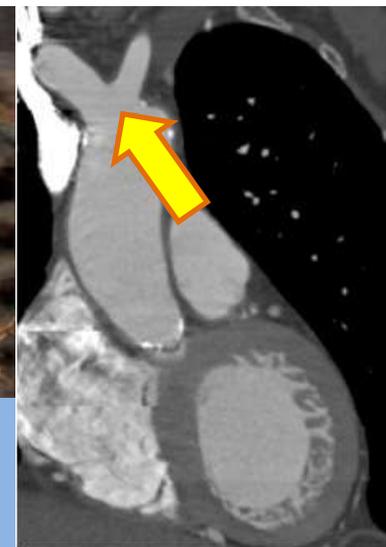
Coarctation in distal arch



RCA originating from LCC



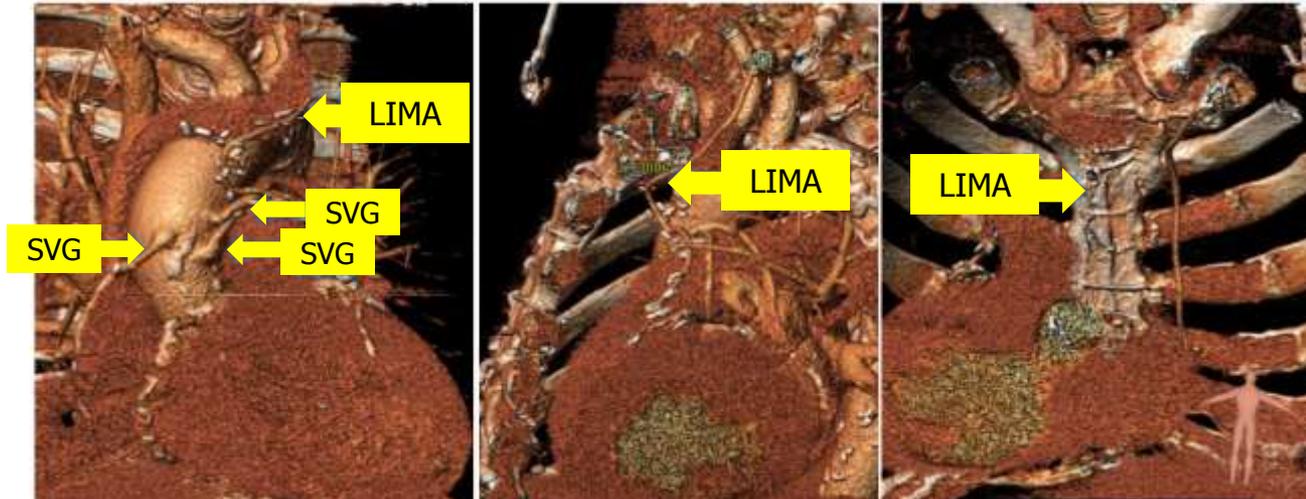
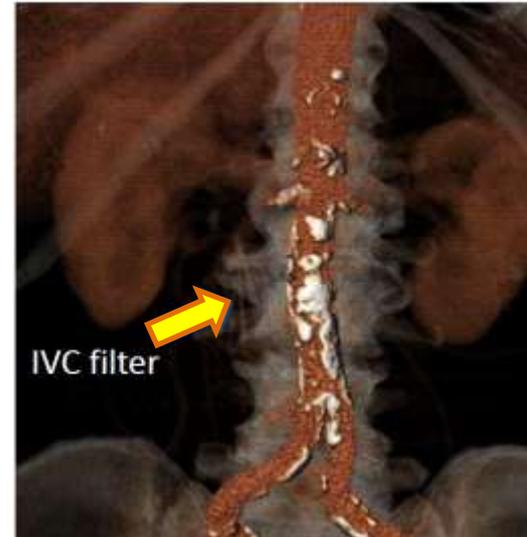
Left common carotid and innominate artery share same origin



trunk. (Bovine arch)

Other findings

findings	%
LIMA pass under sternum	0.3
IVC filter	0.1
LIMA occlusion	0.1
Possible aneurysm SVG	0.1



LIMA appears to travel close to midline

Summary

1. MSCT was systematically used to screen patients for eligibility of a TAVR trial.
2. In the beginning of the trial, the measurements of MSCT was significantly different between site and corelab. The difference became smaller with experiences of CT measurements by the site.
3. Most of annulus calcification extended into LVOT. Annular calcification distributed under LCC and NCC, and under both 2 cusps. The risk of paravalvular leak was ranging from hazard ratio 1.37 to 5.37.
4. Ilio-femoral artery less than 6mm was measured about 30% with hazard ratio of complication 186.20, SAFR > 1.05
5. Left atrial appendage thrombus was detected in approximately 4%.
6. The detection of anomalous vessel was helpful to decide the access route.

Conclusion

MSCT should be recommended for the screening considering all the measurement and abnormalities that could be discovered at the level of the valve, at the level of the aorta and in the peripheral circulation.

Thank You!



Volume 11 - Number 13 - April 2016 - ISSN: 1774-024X

EuroIntervention

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- 1475** Clinical outcomes following "off-label" versus "established" indications of bioresorbable scaffolds for the treatment of coronary artery disease in a real-world population
T. Miyazaki, A. Colombo, et al
- 1479** A novel approach to treat in-stent stenosis: 6- and 12-month results using the everolimus-eluting bioresorbable vascular scaffold
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- 1487** Patient preference regarding assessment of clinical follow-up after percutaneous coronary intervention: the PAPAAYA study
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- 1511** A disaster never comes alone: total ostial occlusion of the left main coronary artery with an anomalous origin
P. Rodrigues, S. Torres, et al

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- 1512** Left atrial appendage occlusion with the AMPLATZER Amulet device: an expert consensus step-by-step approach
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- 1522** The prognostic value of acute and chronic troponin elevation after transcatheter aortic valve implantation
J.M. Sinning, N. Werner, et al
- 1530** Emergency transcatheter aortic valve replacement in patients with cardiogenic shock due to acutely decompensated aortic stenosis
C. Frerker, K.H. Kuck, et al
- 1537** First-in-man report of residual "intra-clip" regurgitation between two MitraClips treated by AMPLATZER Vascular Plug II
M. Taramasso, F. Maisano, et al
- 1541** First transfemoral percutaneous edge-to-edge repair of the tricuspid valve using the MitraClip system
T. Wengenmayer, S. Grundmann, et al
- 1545** First Lotus aortic valve-in-valve implantation to treat degenerated Mitroflow bioprostheses
F. Castriota, A. Cremonesi, et al
- 1549** Direct Flow valve-in-valve implantation in a degenerated mitral bioprosthesis
G. Bruschi, F. De Marco, et al

AsiaIntervention

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Volume 2 - Number 1 - January 2016 - ISSN: 2426-3958

CORONARY INTERVENTIONS

- 19** Late angiographic and clinical outcomes of the novel BioMime™ sirolimus-eluting coronary stent with ultra-thin cobalt-chromium platform and biodegradable polymer for the treatment of diseased coronary vessels: results from the prospective, multicentre meriT-2 clinical trial
- 28** Impact of chronic lung disease after percutaneous coronary intervention in Japanese patients with acute coronary syndrome
- 36** Distribution characteristics of coronary calcification and its substantial impact on stent expansion: an optical coherence tomography study
- 44** Smooth arterial healing after paclitaxel-coated balloon angioplasty for in-stent stenosis assessed by optical frequency domain imaging
- 48** Mediastinal haematoma complicating percutaneous coronary intervention via the radial artery

INTERVENTIONS FOR STRUCTURAL HEART DISEASE AND HEART FAILURE

- 49** Comparison of aortic annulus dimensions between Japanese and European patients undergoing transcatheter aortic valve implantation as determined by multi-detector computed tomography: results from the OCEAN-TAVI and a European single-centre cohort
- 57** Combined percutaneous transvenous mitral commissurotomy and left atrial appendage closure as an alternative to anticoagulation for rheumatic atrial fibrillation

EDITORIAL

- 7** Evolution and current status of interventional cardiology in India
- 10** Tailoring TAVI in Asia: insights from MSCT
- 13** Opening the shell for better stent results

ASIA-PACIFIC HOTLINES AT TCT 2015

- 16** Asia-Pacific Hotlines at TCT 2015: a prospective randomised trial of paclitaxel-eluting vs. everolimus-eluting stents in diabetic patients with coronary artery disease (TUXEDO)
- 17** Asia-Pacific Hotlines at TCT 2015: bioresorbable vascular scaffolds versus metallic stents in patients with coronary artery disease (ABSORB China Trial)
- 18** Asia-Pacific Hotlines at TCT 2015: evaluation of initial surgical versus conservative strategies in patients with asymptomatic severe aortic stenosis (The CURRENT AS registry)

HOW SHOULD I TREAT?

- 58** How should I treat a patient with critical stenosis of a bifurcation of the left main coronary artery with an acute angulation between the left main artery and the left circumflex artery?
- 65** How should I treat a percutaneous posteromedial mitral periprosthetic paravalvular leak closure in a bioprosthesis with no radiopaque ring?