21st CardioVascular Summit
TCTAP 2016

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

Patrick W. Serruys[1],
Hiroki Tateishi[2], Yosuke Miyazaki[2],
Mohammad Abdelgani[3], Yoshinobu Onuma[2]

[1] National Heart Lung Institute Imperial College, London, The United Kingdom
[2] Thoraxcenter, Erasmus Medical Center, Rotterdam, The Netherlands
[3] Academic Medical center, Amsterdam, The Netherlands

Live Case Session 4, Complex PCI
Coronary & Valve Theater, Level 1 April 28, 2016, 3:00 PM~ 3:15 PM

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.

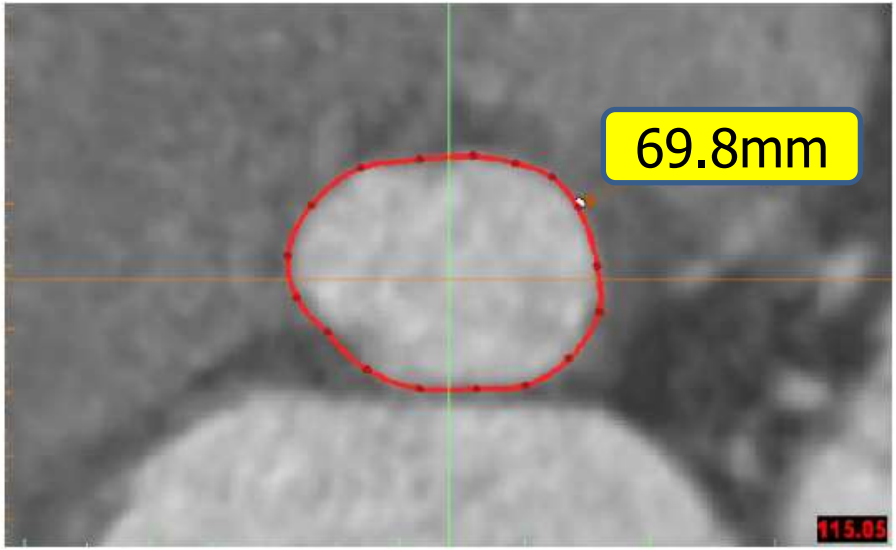
Study Population

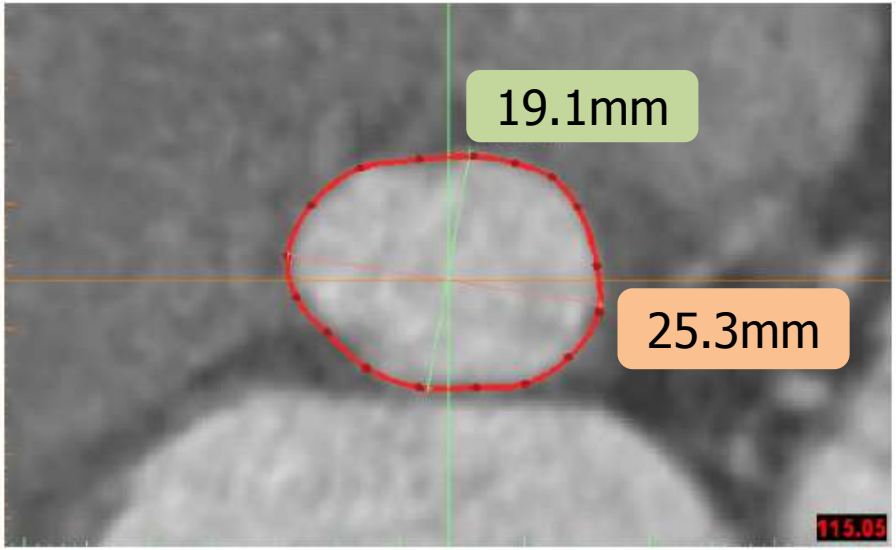
- Population: 881 consecutive patients who were screened with Multi-Slice Computed Tomography (MSCT) in TAVR trials from Jan 2013 to July 2015.
- MSCT images were interpreted/analyzed by site and by imaging corelab in 846~881 depending on the type of parameter.

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.

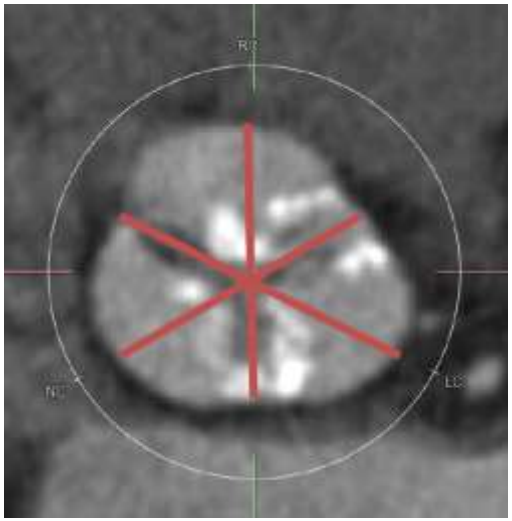
Aortic annulus measurements (Systole)



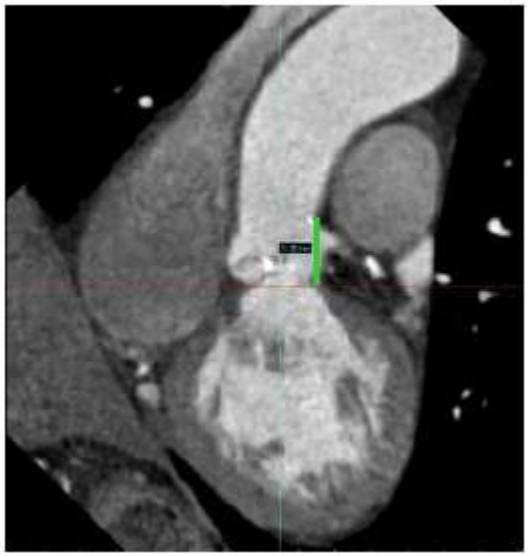


- (left) Example of perimeter measurement
- (right) Major and minor diameter measurements.

Aortic annulus measurements (Diastole)



Example of sinus of Valsalva diameters.

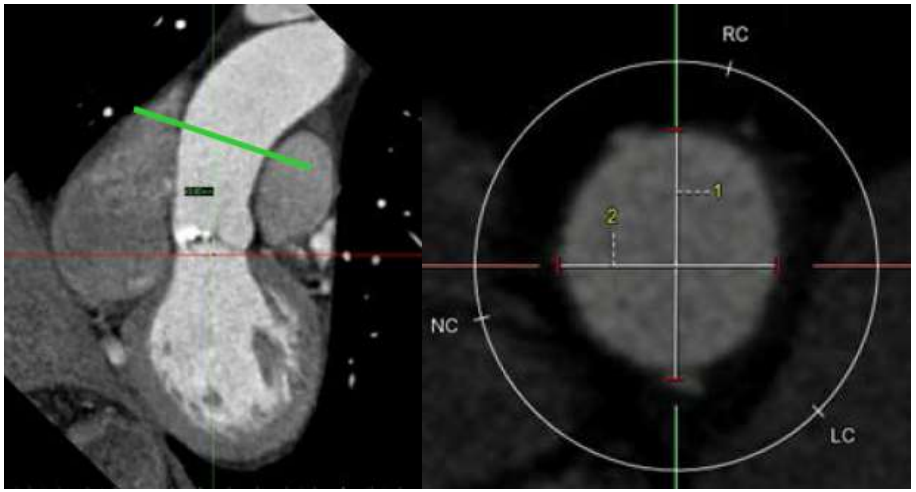


Sinus of Valsalva Height (Left)

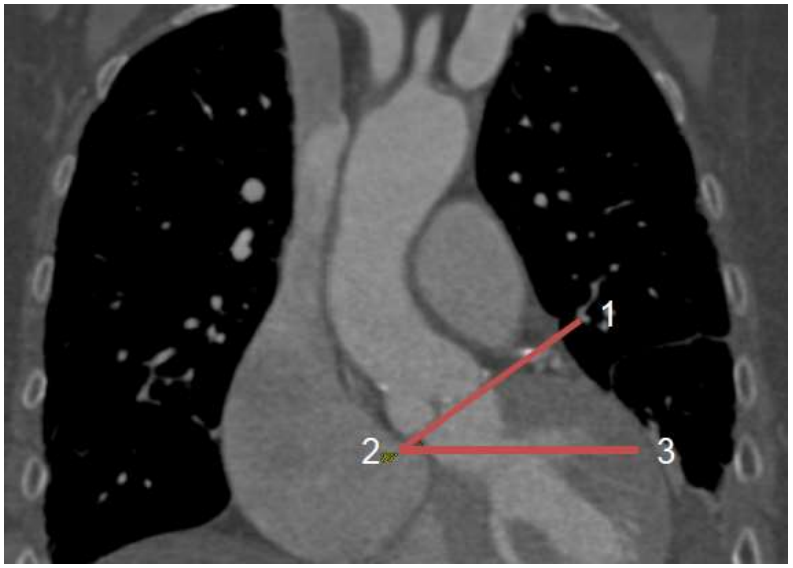
Sinus of Valsalva Heights (Non)

Sinus of Valsalva Heights (Right)

Aortic annulus measurements (Diastole)

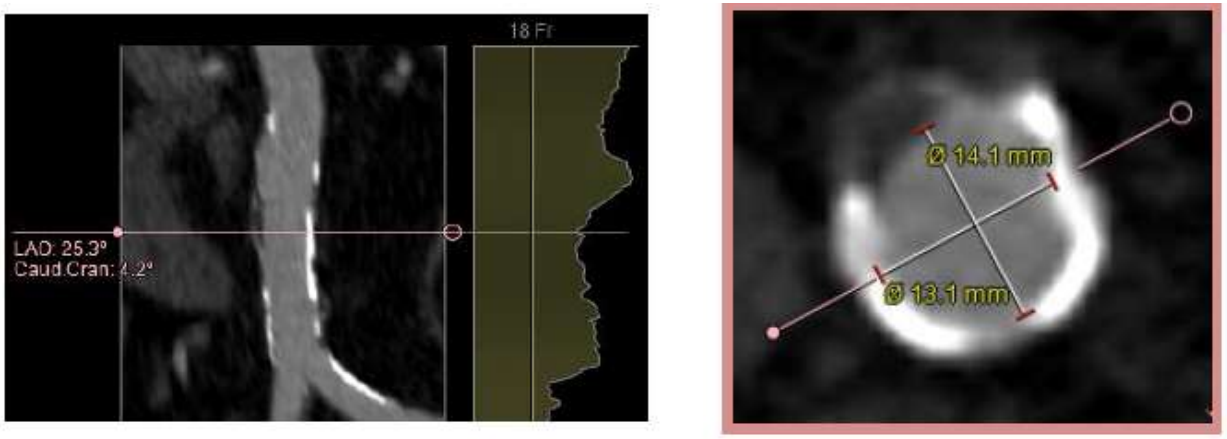


Oblique coronal with measurement of 40mm above the aortic annulus (left) and double-oblique reformatted to be perpendicular to that location (right).

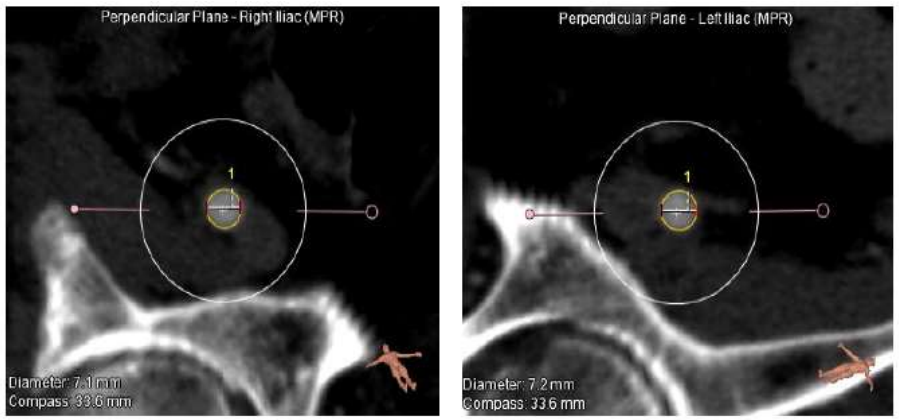


Aortic root angulation measurement on the standard coronal image.

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

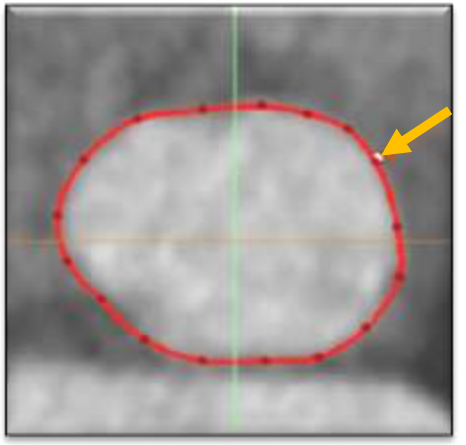
variable	n=881
LV Ejection Fraction	60.0±10.9%
Severe Diastolic Dysfunction	1.9%
PH (Systolic Pressure 60-80 mmHg)	2.9%
Severe Aortic Calcification	11.4%
BNP ≥ 550 pg/mL	16.0%
NT proBNP ≥ 3200 pg/mL	15.6%
creatinine, mg/dl*	1.1±0.3
STS Risk of Mortality	4.4±1.6
EuroSCORE Logistic	9.7±9.1
EuroSCORE II	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

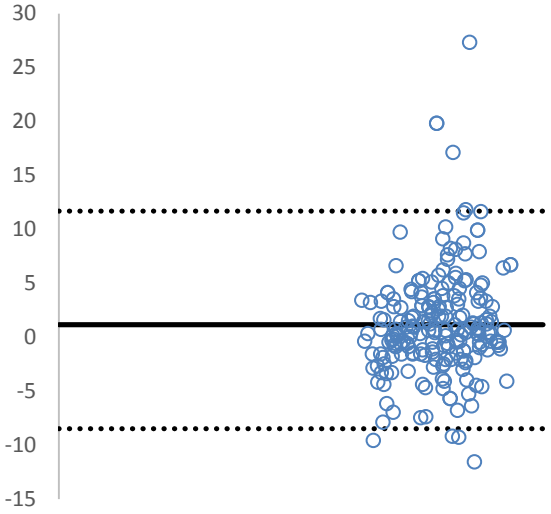
n=881	Site		Corelab	P-value
Annulus mean diameter	24.58±2.28	<	24.90±2.26	<0.001
Major annulus diameter	27.22±2.72	<	27.48±2.64	<0.001
Minor annulus diameter	21.84±2.40	<	22.25±2.33	<0.001
Aortic Annulus perimeter	78.50±7.16	=	78.35±7.01	0.220
Aortic root angulation	46.80±8.57	<	48.04±8.08	<0.001
Max 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



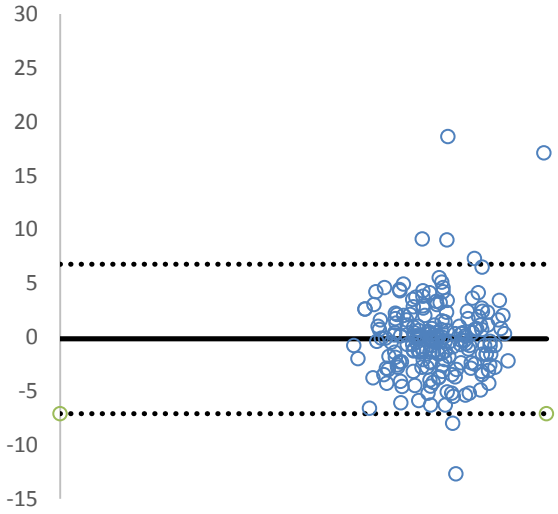
Site measurements – Corelab measurements

Mean difference 1.15
Limit of Agreement
-8.50 to 10.82



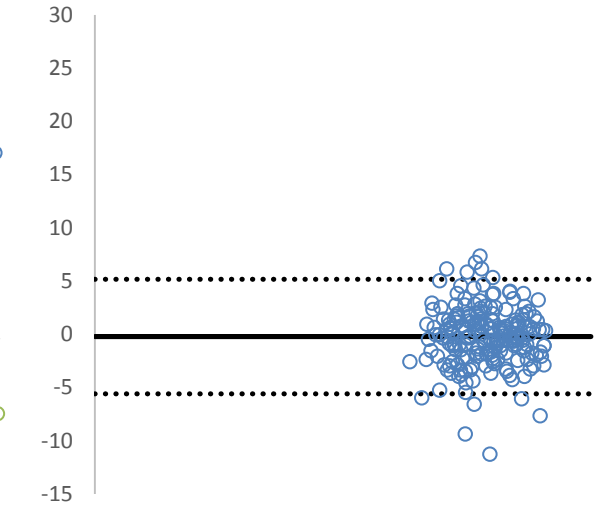
First wave(n=200)

Mean difference -0.16
Limit of Agreement
-7.10 to 6.77



Second wave(n=200)

Mean difference -0.22
Limit of Agreement
-5.60 to 5.16



Third wave(n=200)

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

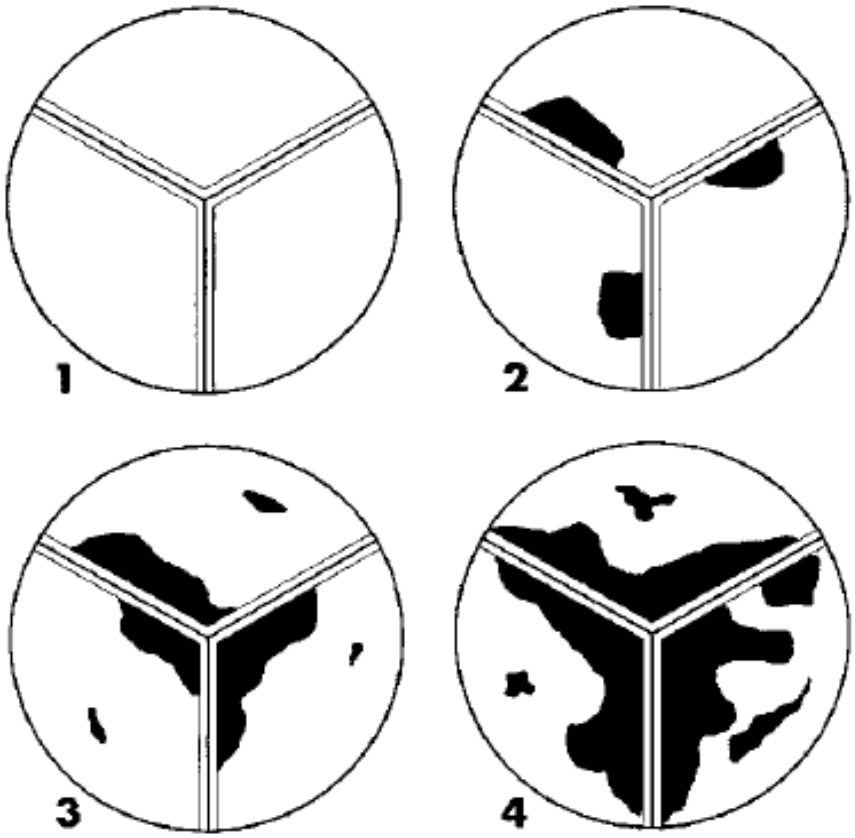
Predictors of Prostar Failure

	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

Prostar XL Perccutaneous Vascular Surgical System® for vessel closing

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

Classification of aortic valve calcification



Grade 1: no calcification

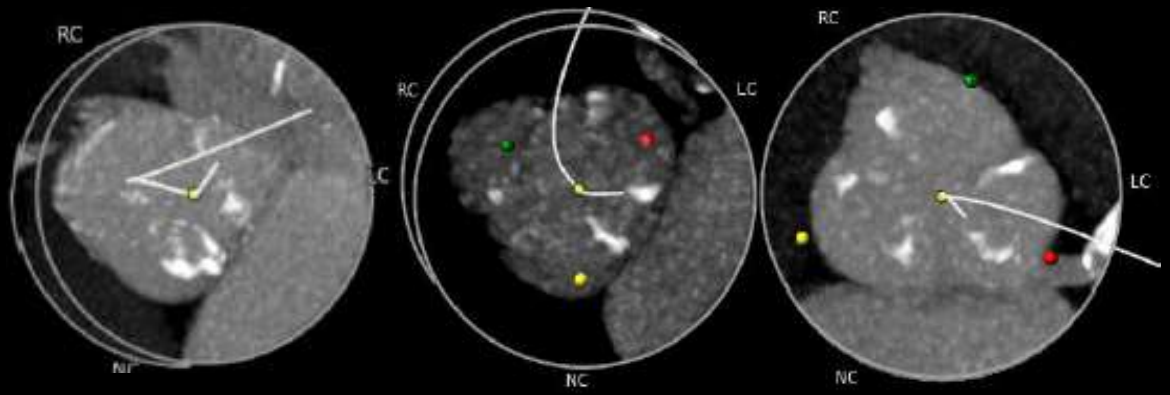
Grade 2: mild calcification (small isolated spots of calcification)

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

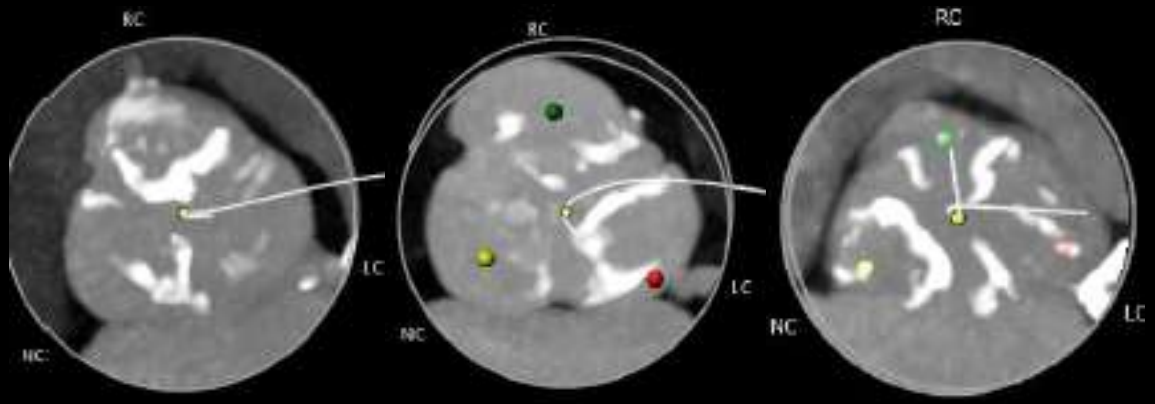
Grade 4: heavy calcification (extensive calcification of all aortic valve leaflets)

Tomaszewski, K. A. et at; Radiology, 2002

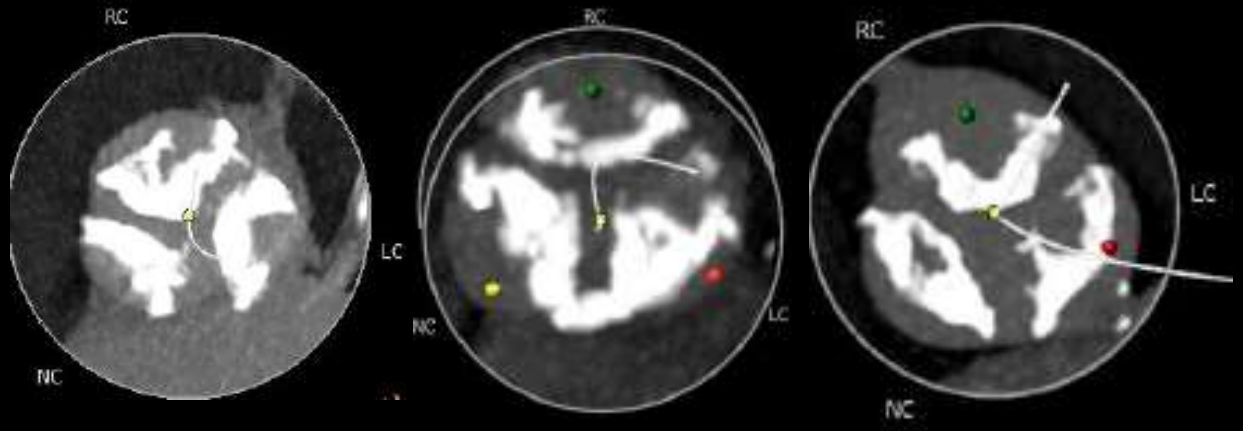
Grade 2



Grade 3



Grade 4

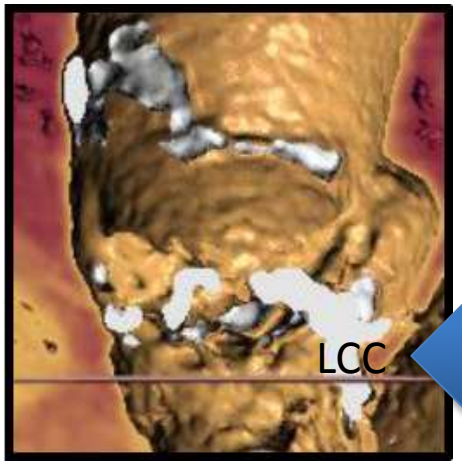


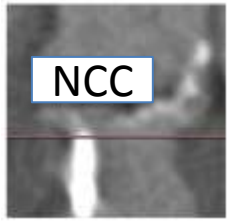
Degree and location of calcification

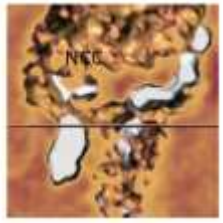
degree	1	2	3	4
n=881	0%	11%	51%	39%

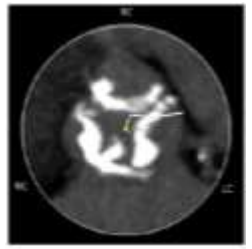
locate	All leaflets	L+R	L+N	R+N
n=881	98%	0.3%	1.1%	0.7%

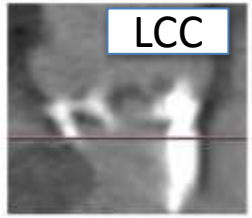
Aortic annulus and LV outflow tract calcification

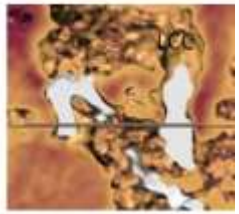








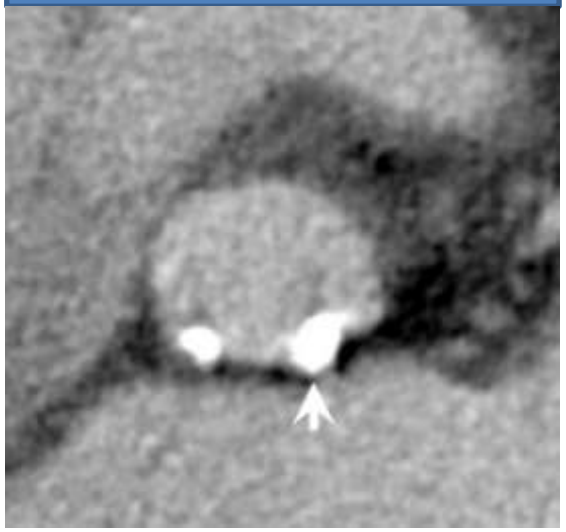




	Isolated annulus calc. (%)	Annulus calc. extending into LVOT(%)	Total(%)
	2.5	**16.1**	**18.6**
Under LCC	1.2	6.4	7.6
Under NCC	0.3	4.5	4.8
Under RCC	0.5	0.9	1.4
Under 2 or 3 capsid	0.5	4.3	4.8

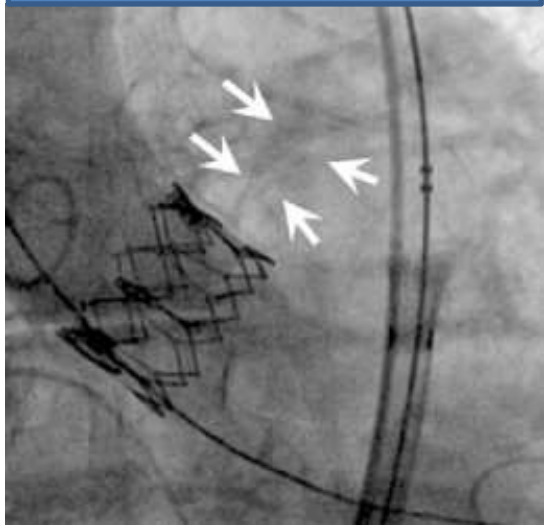
LVOT calcification and annulus rupture

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



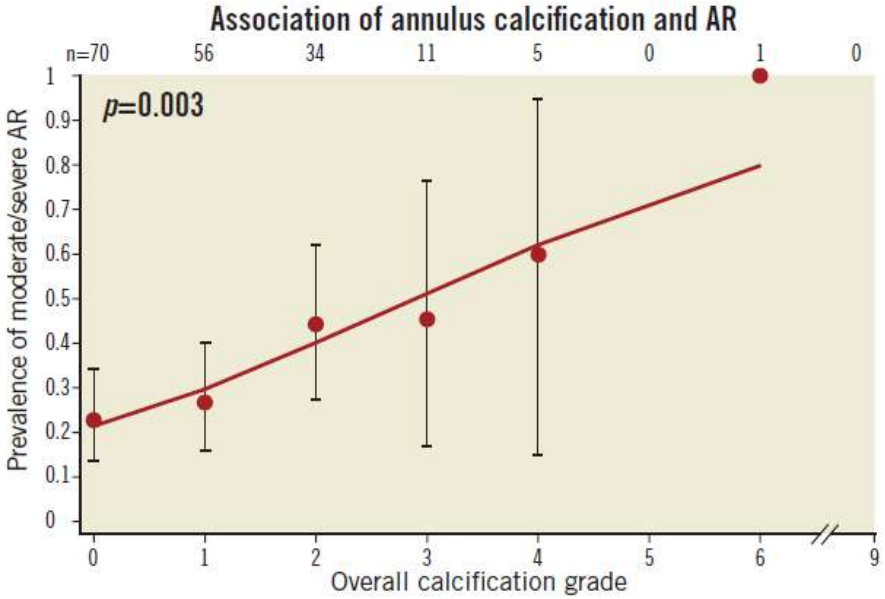
Post-procedural CT scan showed contrast leakage due to annulus rupture

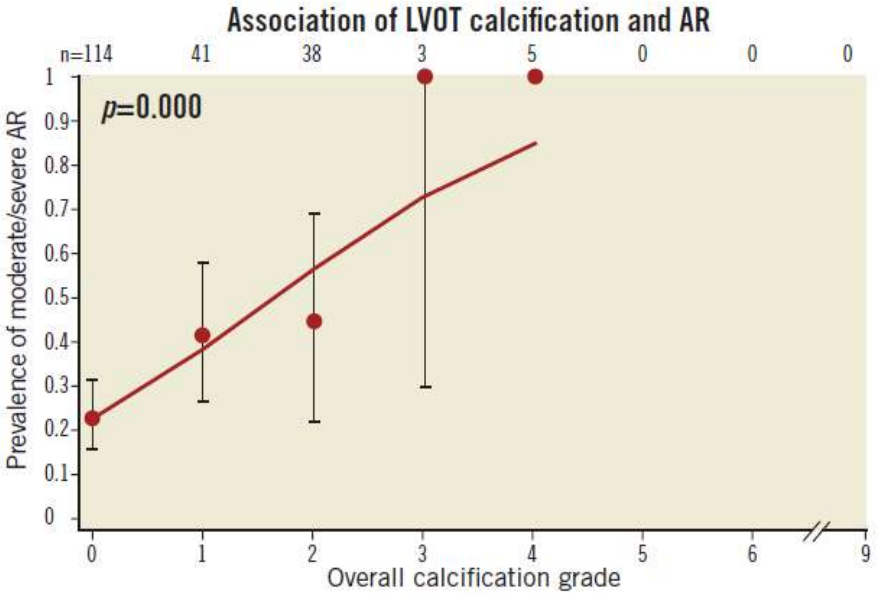
Aortography showed contrast effusion from the aortic cusp



JACC cardiovascular intervention 2013; Kentaro Hayashida, Thierry Lefèvre et al

Annulus and LVOT calcification predict aortic regurgitation after TAVR





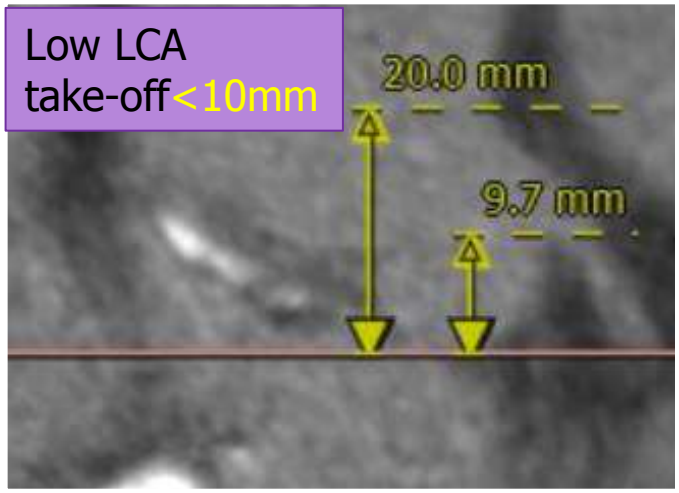
Grade 0	No calcification
Grade 1 (mild)	Small, non-protruding calcification
Grade 2 (moderate)	Protruding (>1 mm) or extensive (>50% of cusp sector) calcification
Grade 3 (severe)	Protruding (>1 mm) and extensive (>50% of cusp sector) calcification

LVOT: left ventricular outflow tract

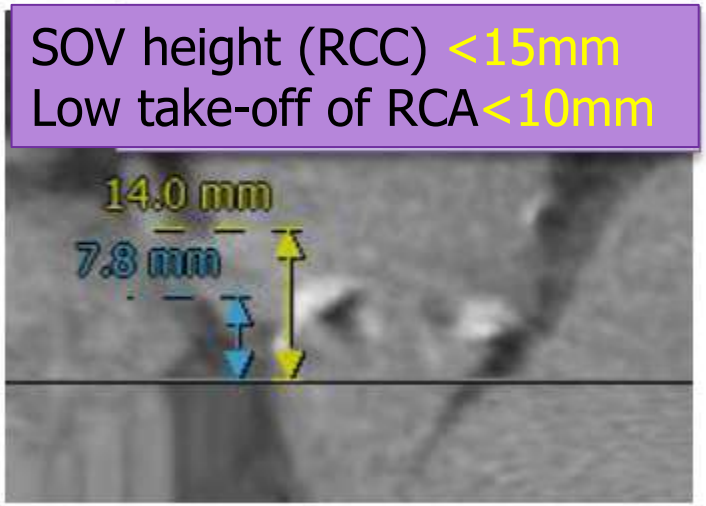
Eurointervention 2014; Lutz Buellesfeld, Stephan Windecker et al

Coronary take-off and Sinus of Valsalva Height

Left Coronary Cusp



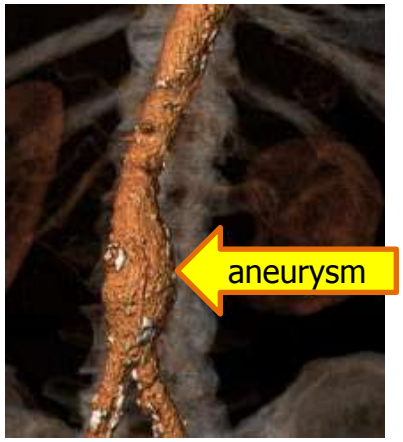
Right Coronary Cusp

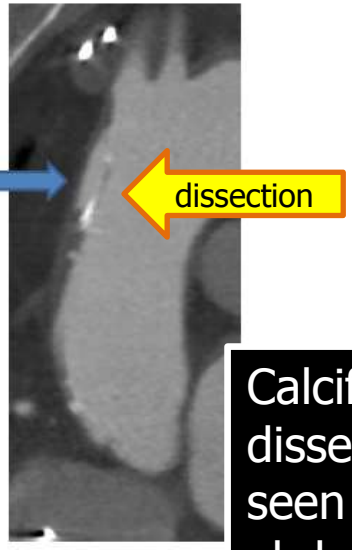


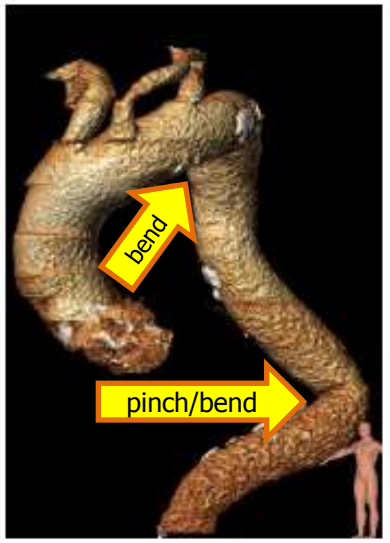
Take-off	%
Low take-off LCA	4.0
Low take-off RCA	0.8
Low SOV Height	1.2

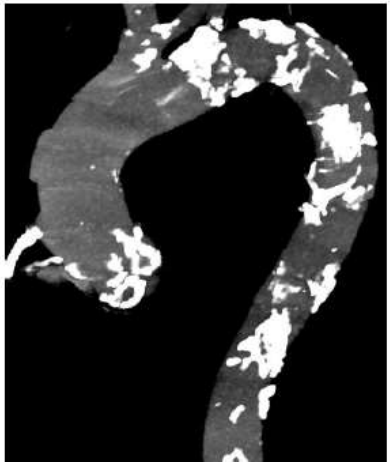
Aortic root disease

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	

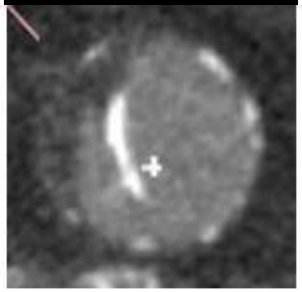






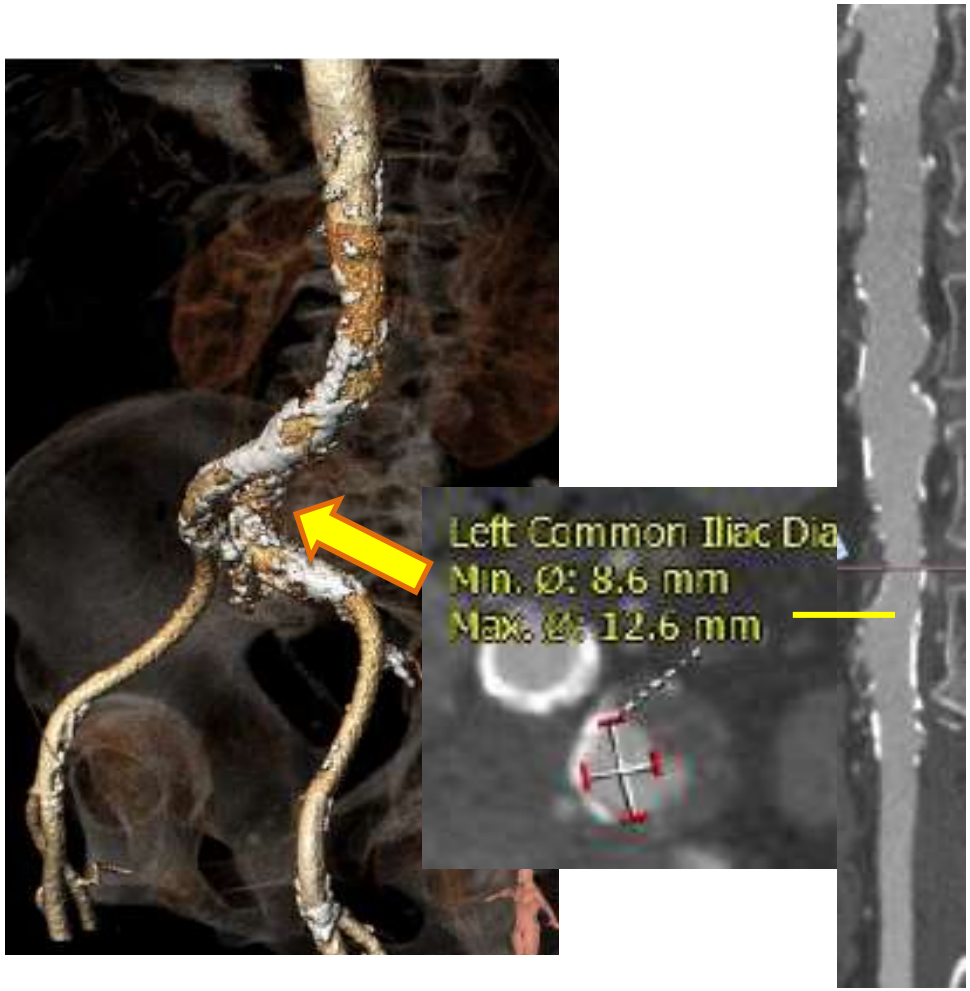


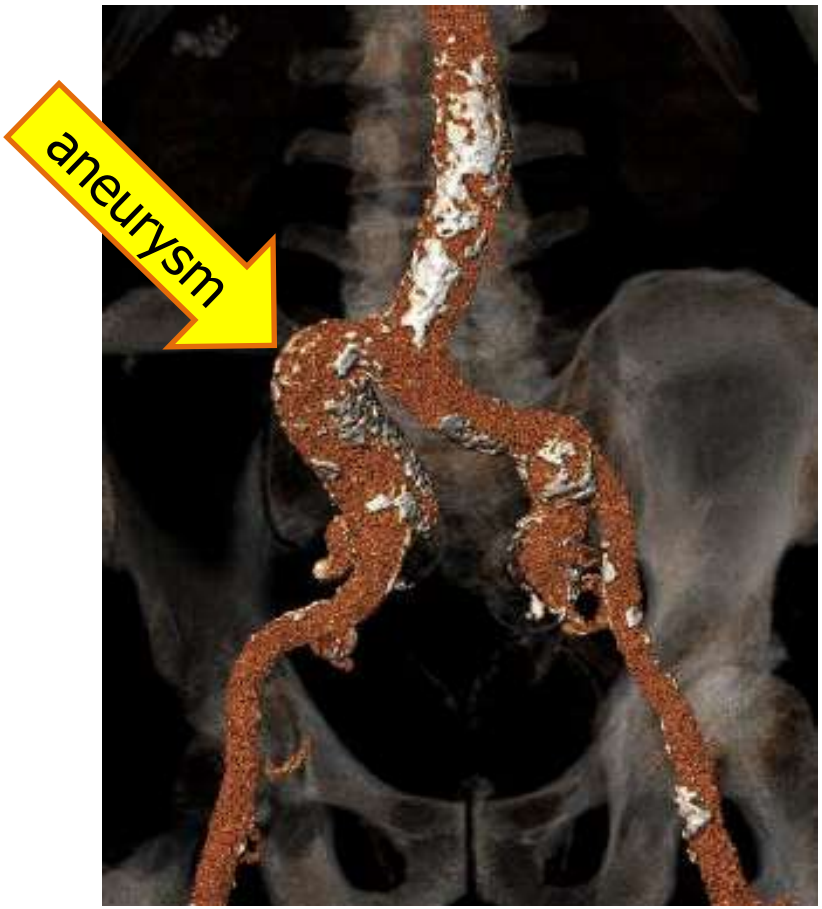
Calcified dissection seen in abdominal aorta



Access site related disease

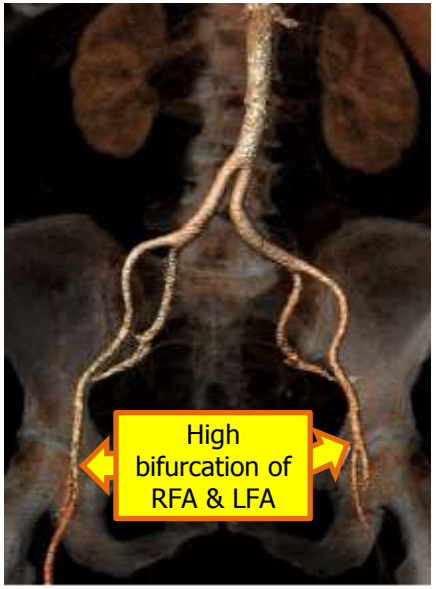
	Calcification (%)	<6mm (%)	Tortuous/ bend(%)	Plaque/ thrombus(%)	Aneurysm (%)	Dissection (%)
Ilio-femoral artery	98	33	6.8	4.8	2.2	1.6

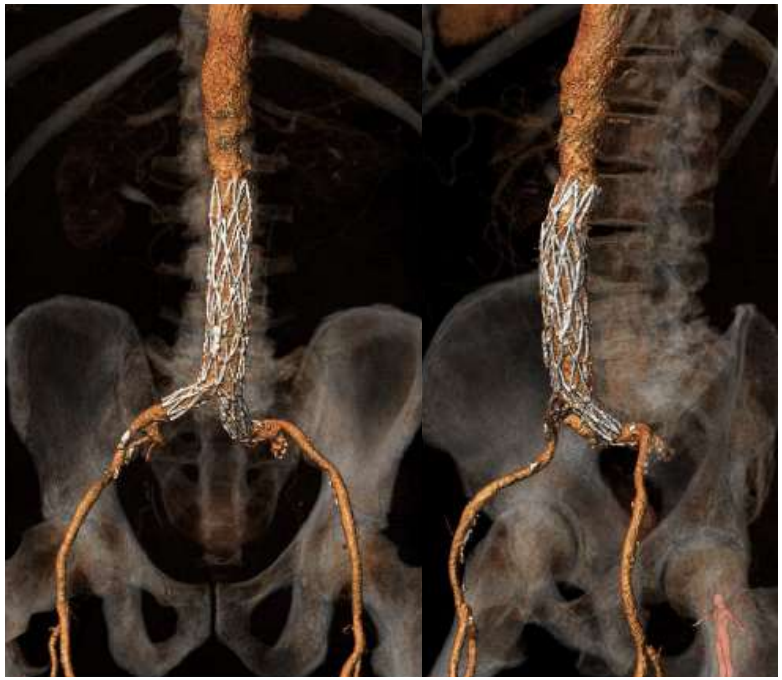


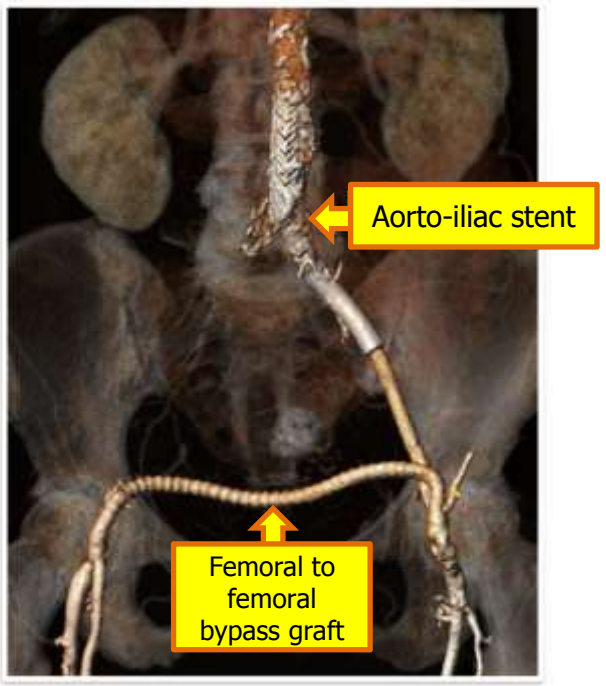


Access site related disease

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

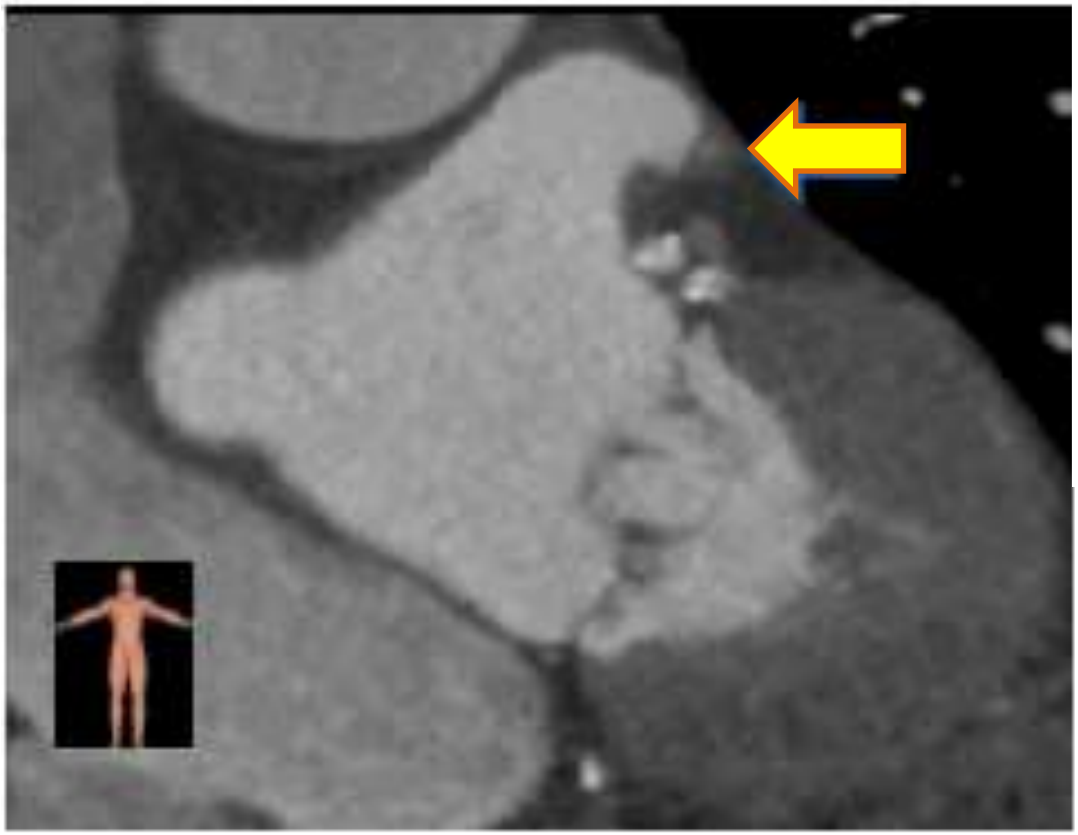


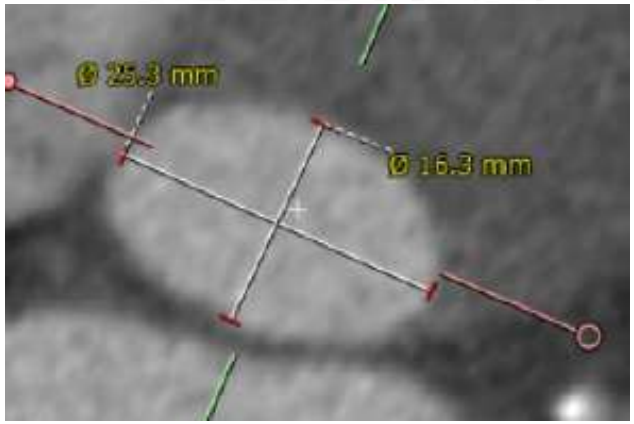




Cardiac findings

findings	%
Possible LAA thrombus	3.7
Eliptical LVOT	0.8

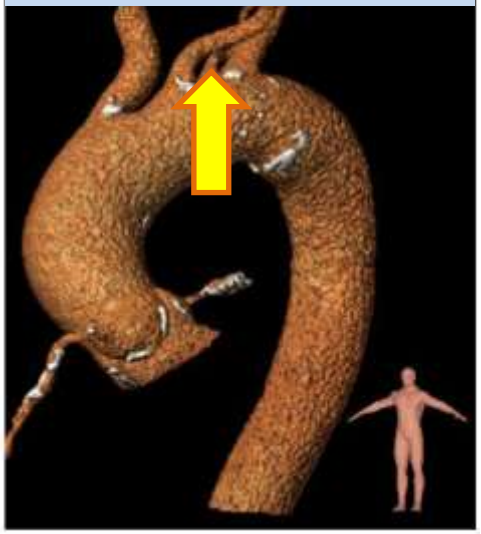




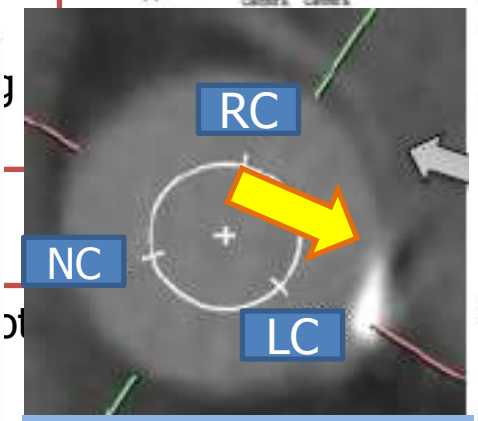
Anomalous vessel and etc

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

Anomalous vessel arises from the aortic arch



Coarctation in distal arch



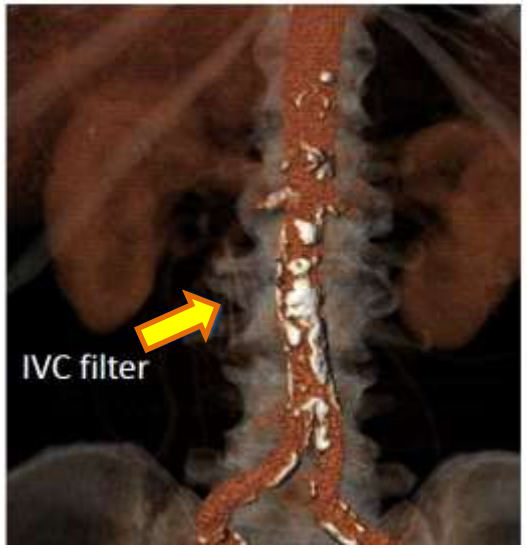
RCA originating from LCC

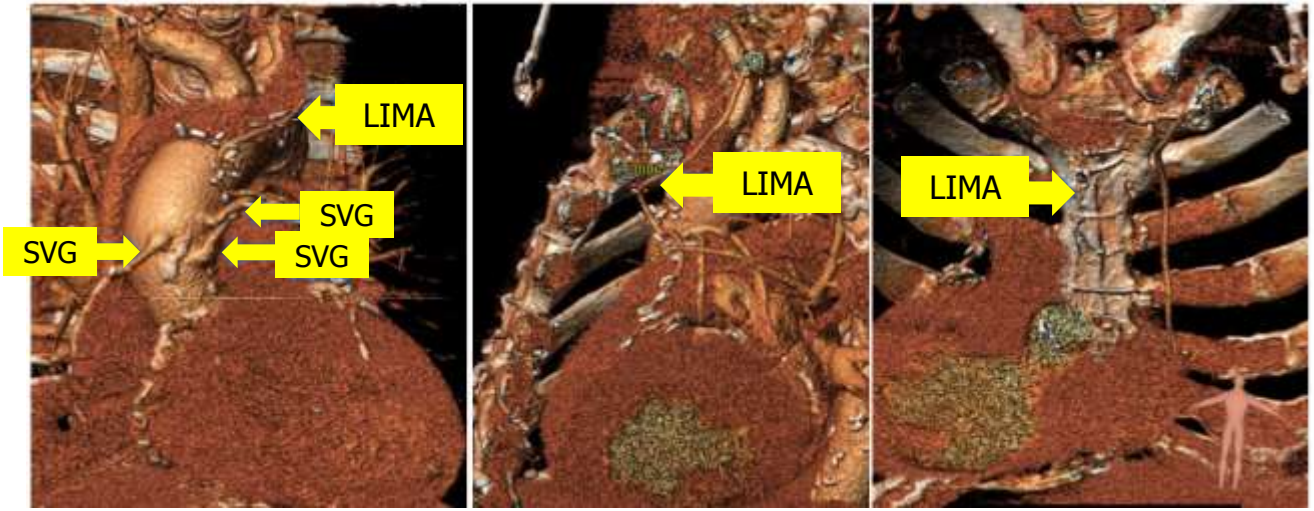
Left common carotid and innominate artery share same origin

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!

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EDITORIAL

ASIA-PACIFIC HOTLINES AT TCT 2015

HOW SHOULD I TREAT?