

CT Algorithm for Optimal TAVR With Sapien 3

Do-Yoon Kang, MD.

University of Ulsan College of Medicine,
Heart Institute, Asan Medical Center, Seoul, Korea

Conflict of Interest Statement

I have nothing to disclose.

Risk Stratification for SAVR vs. TAVR

Surgical Clinical Risk

STS score
Age, Gender
Diabetes, Hypertension
Heart failure
Renal dysfunction
Lung disease
Cerebrovascular disease
Previous Surgery
Malignancy
Frailty

TAVR Anatomic Risk

Bicuspid AV
Aortic valve size
Heavy Calcification
Low coronary height
Landing zone anatomy
Coronary artery disease
Mitral/Tricuspid disease
Porcelain aorta
Bicuspid aortopathy
Vascular access

Risk Stratification for SAVR vs. TAVR

Surgical Clinical Risk

In 2019, TAVR showed better outcomes Even in patients with Low surgical risk !



TAVR Anatomic Risk

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Risk Stratification for SAVR vs. TAVR

Surgical Clinical Risk

In 2019, TAVR showed better outcomes Even in patients with Low surgical risk !

TAVR Anatomic Risk

Bicuspid AV
Aortic valve size
Heavy Calcification

Anatomic risk evaluation became more Important for treatment decision-making.

David H. Ada
John K. Forrest, M
Nicolo Piazza,
George Petr
Michael J. Bouh
and Michael J.

ORIGINAL ARTICLE

Transcatheter Aortic-Valve Replacement with a Balloon-Expandable Valve in Low-Risk Patients

M.J. Mack, M.B. Leon, V.H. Thourani, R. Makkar, S.K. Kodali, M. Russo, S.R. Kapadia, S.C. Malaisrie, D.J. Cohen, P. Pibarot, J. Leipsic, R.T. Hahn, P. Blanke, M.R. Williams, J.M. McCabe, D.L. Brown, V. Babaliaros, S. Goldman, W.Y. Szeto, P. Genereux, A. Pershad, S.J. Pocock, M.C. Alu, J.G. Webb, and C.R. Smith, for the PARTNER 3 Investigators*

Porcelain aorta
Bicuspid aortopathy
Vascular access

MDCT Analysis is Essential for TAVR Anatomic Risk Evaluation

1. Suitable Aortic Root Anatomy
2. Device and Size Selection
3. Coronary Disease Status
4. Aortic, Iliac and Femoral Anatomy
5. Optimal Fluoroscopic Projection Angulation

Valve Sizing Matters

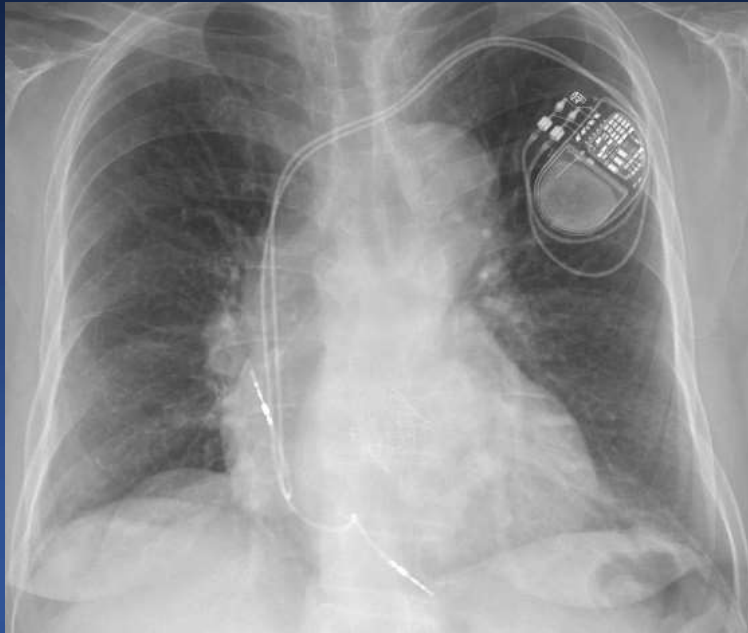
Oversize

Undersize



Permanent Pacemaker
Annular Rupture

Paravalvular Regurgitation
Valve Embolization

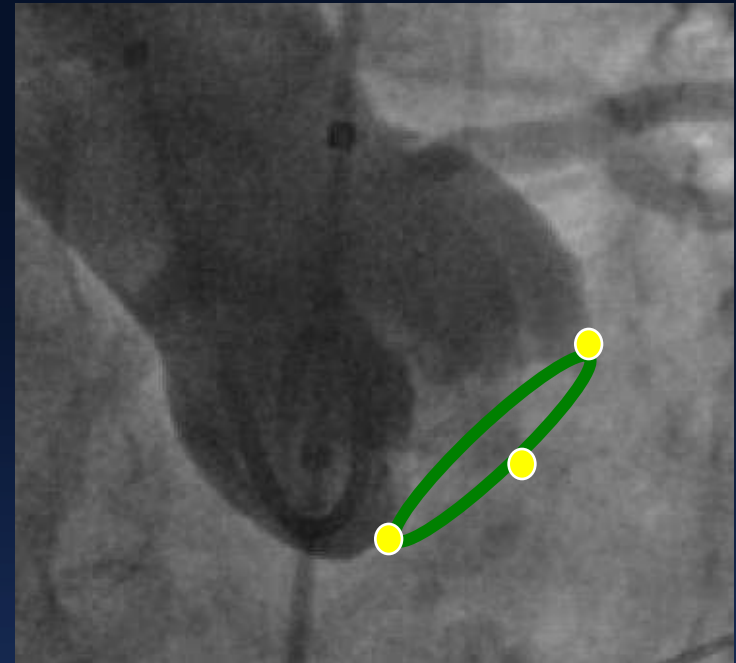
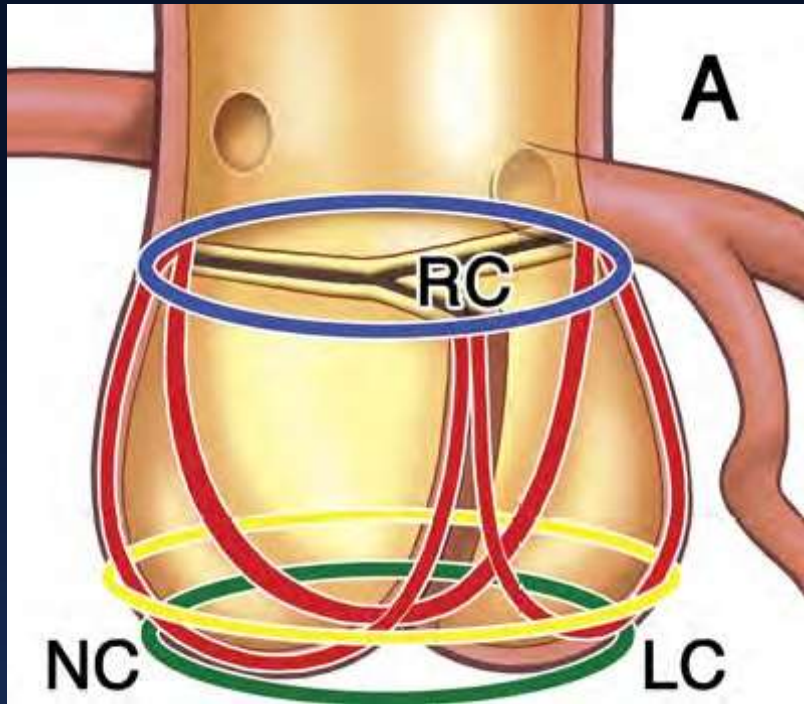


VS.



Virtual Basal Ring

Correct Assessment of Annulus Size



— Sinotubular junction

— Aortic leaflets

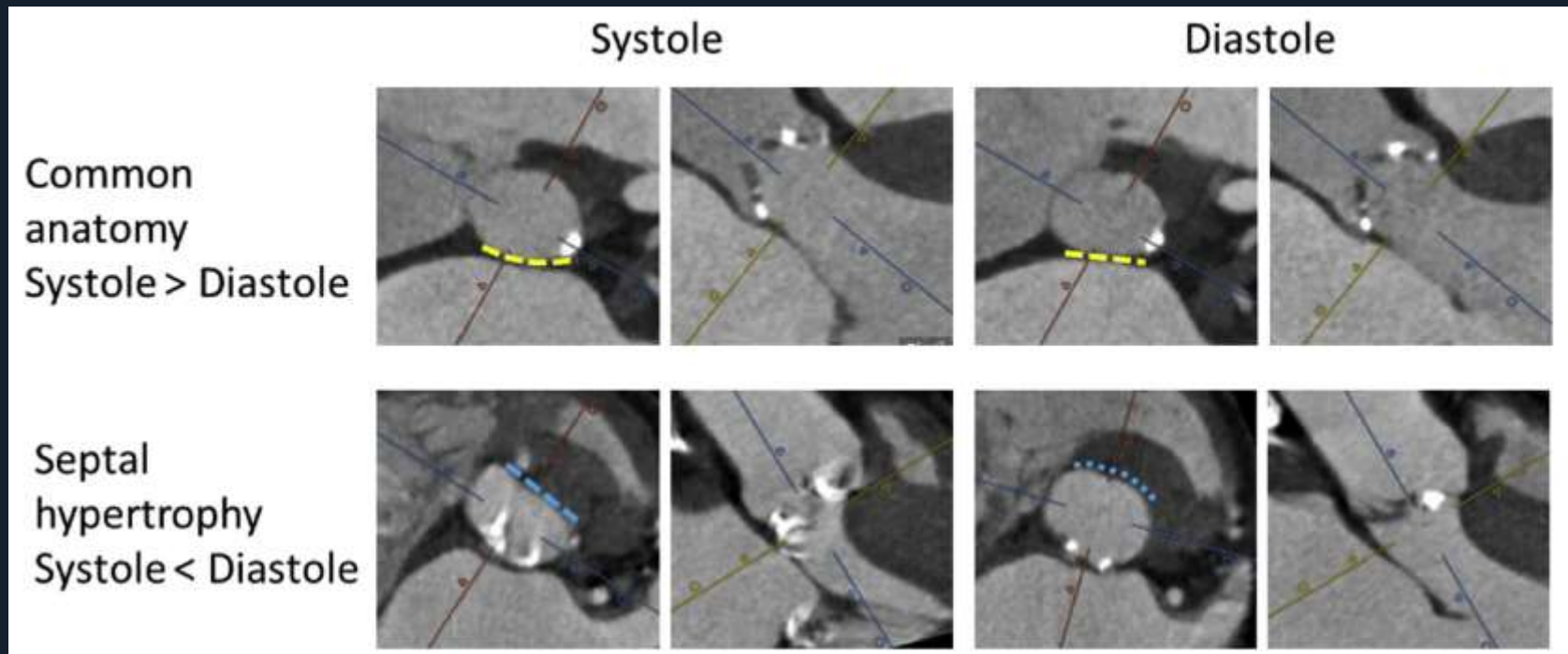
— Aortoventricular junction

— Aortic Annulus
: virtual ring formed by
base of AV leaflets

RC = Right coronary cusp; NC = Non-coronary cusp; LC = Left coronary cusp

Annular dynamism

- Annular size changes throughout cardiac cycle
→ Measurement at end-systolic phase
- Check the diastolic phase in case of septal hypertrophy



Balloon-Expandable SAPIEN 3 Valve



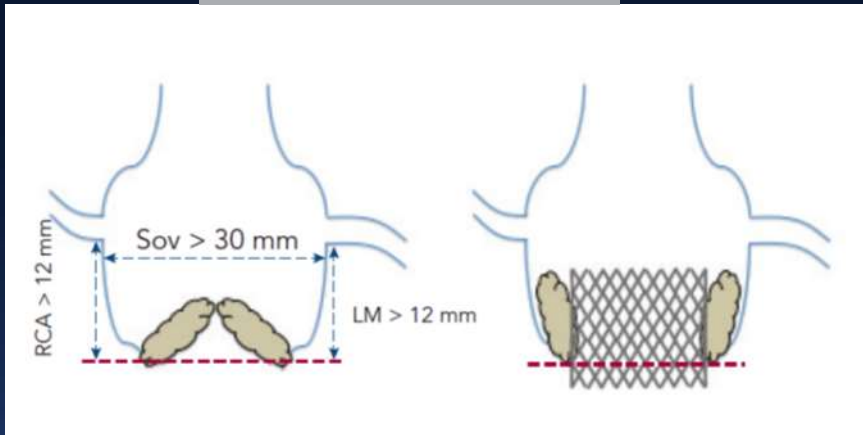
$$\text{Area Oversizing \%} = \frac{\text{nominal Sapien 3 area}}{\text{Systolic annular area}} \times 100$$

Adjusting S3 Sizing By Balloon Volume (Over or Under filled)

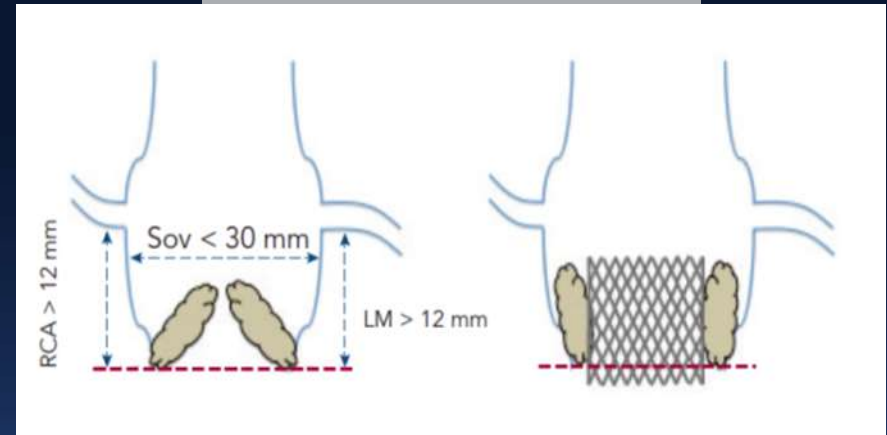
22 mm	- 1cc
23 mm	
24 mm	+ 1cc
25 mm	- 2cc
26 mm	
27mm	+ 2cc
28mm	- 3cc
29 mm	
30 mm	+ 3cc

Risk of Coronary Obstruction

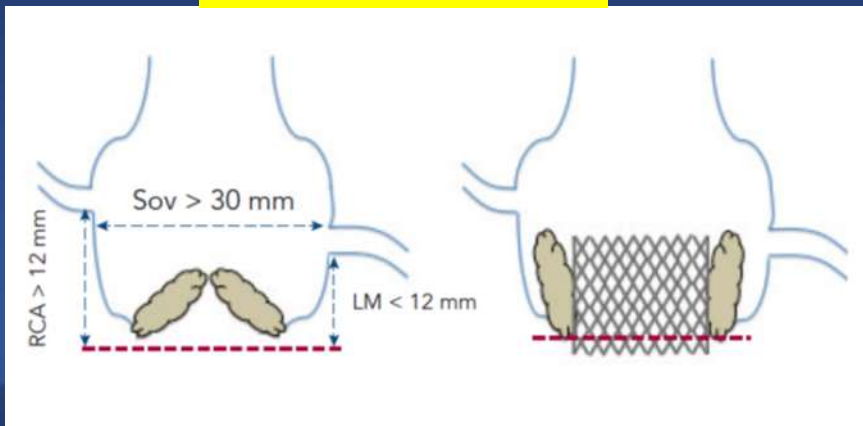
Wide and High



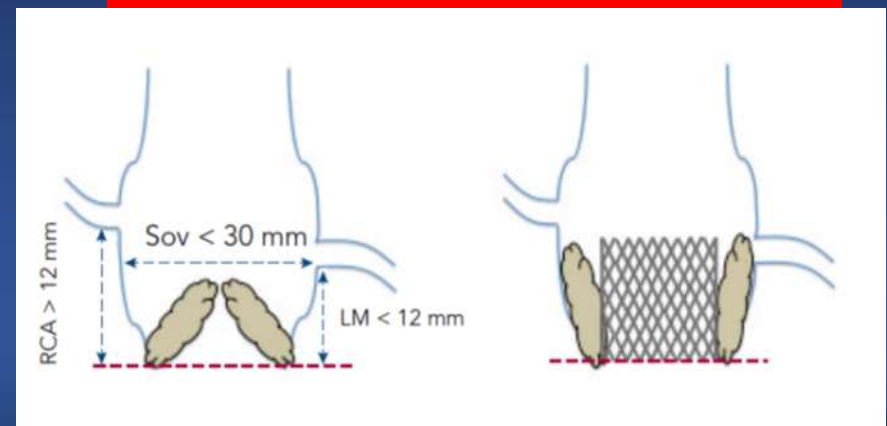
Shallow and High



Wide and Low



Shallow and Low (<10mm)

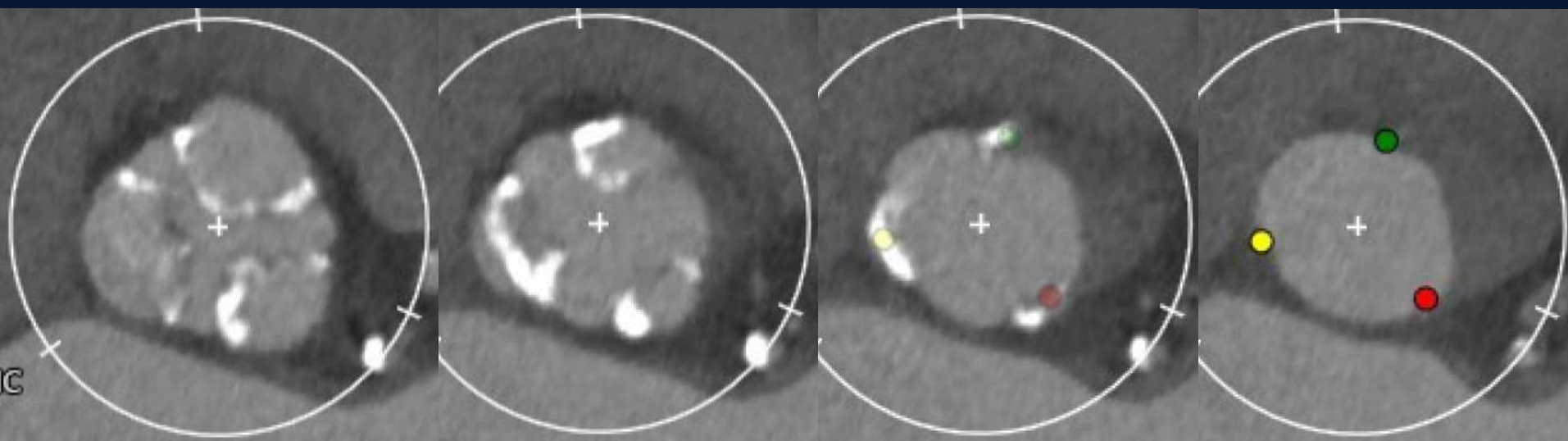


S3 Area Oversizing Based on the CT

15%, Cutoff

<i>Mild Calcification (Ca volume < 400 mm³)</i>	<i>10~15%, then Overfill</i>
<i>Moderate Calcification (Ca volume 400-1000 mm³)</i>	<i>5~10%, then Overfill</i>
<i>Severe Calcification (Ca volume > 1000 mm³)</i>	<i>0~5%, then Overfill</i>
<i>Bicuspid AS and Heavy Calcification</i>	<i>0%, then Overfill</i>

Case #1, 85/M with Severe AS



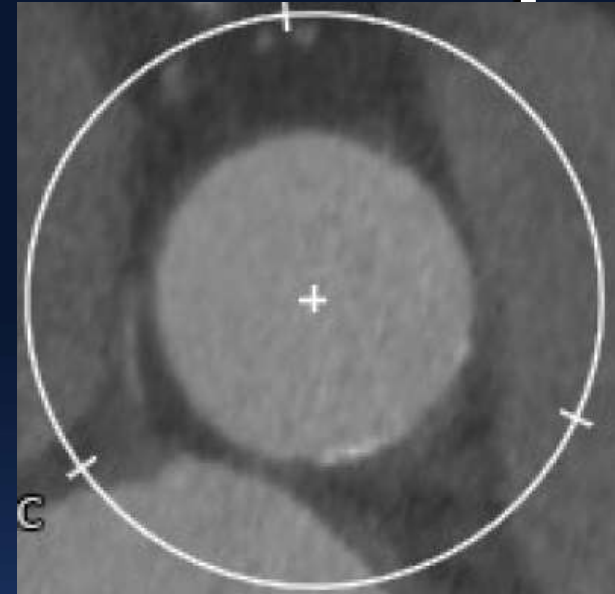
Annulus plane

Aortic Annulus parameters	
Annulus short diameter	21.8 mm
Annulus long diameter	25.6 mm
Annulus mean diameter	23.7 mm
Annulus area	435 mm ²
Annulus area-driven diameter	23.5 mm
Annulus perimeter	74.5 mm
Annulus perimeter-driven diameter	23.7 mm

CT findings – Aortic Valve Complex



Sinus of Valsalva



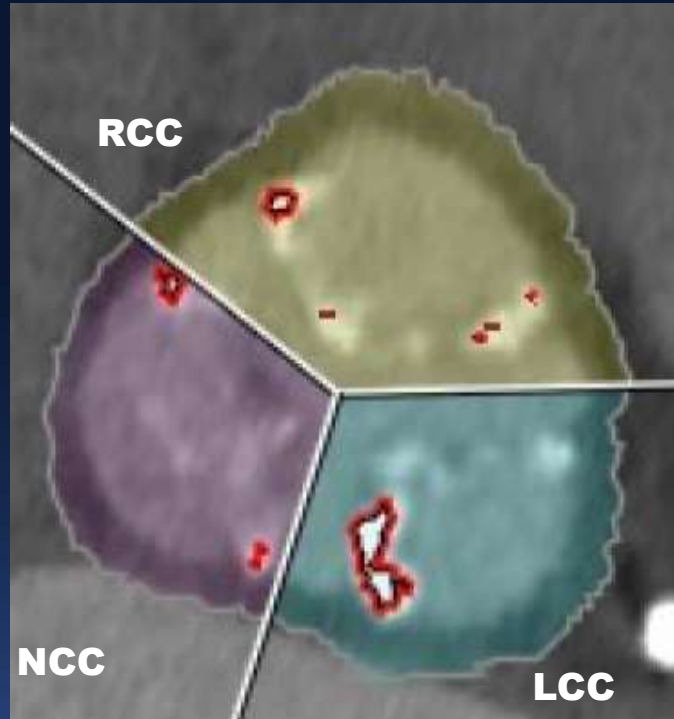
STJ

Sinus of Valsalva		STJ	
Area	830 mm²	Area	630 mm²
Sinus / Annulus Area Ratio	1.91	STJ/ Annulus Area Ratio	1.45
NCC diameter	30.6 mm	Mean diameter	28.2 mm
LCC diameter	33.5 mm		
RCC diameter	31.0 mm		

Mean Sinus / Annulus Area Ratio **1.83 ± 0.27**

Mean STJ / Annulus Area Ratio **1.49 ± 0.29**

Calcium Amount



Calcium volume	
NCC	84 mm ³
RCC	62 mm ³
LCC	48 mm ³
Total	194 mm ³

S3 Area Oversizing Based on the CT

15%, Cutoff

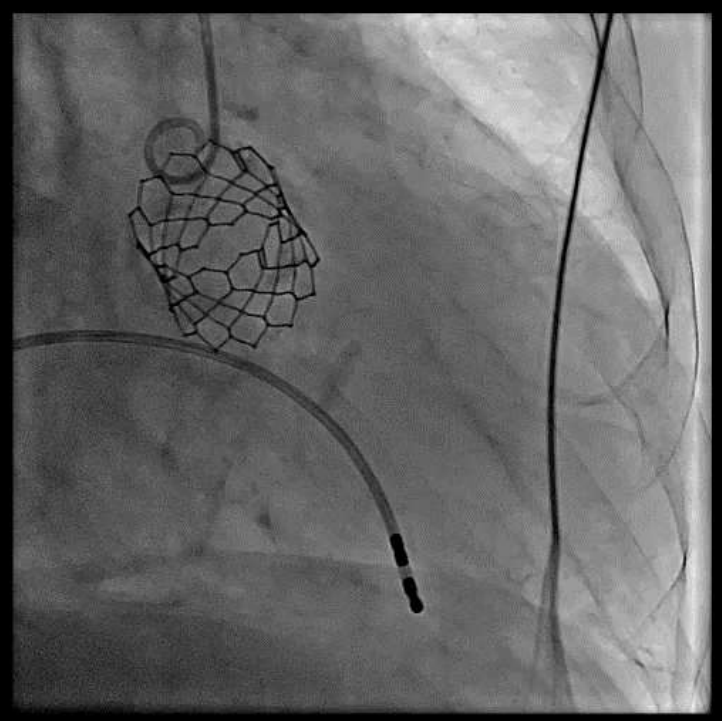
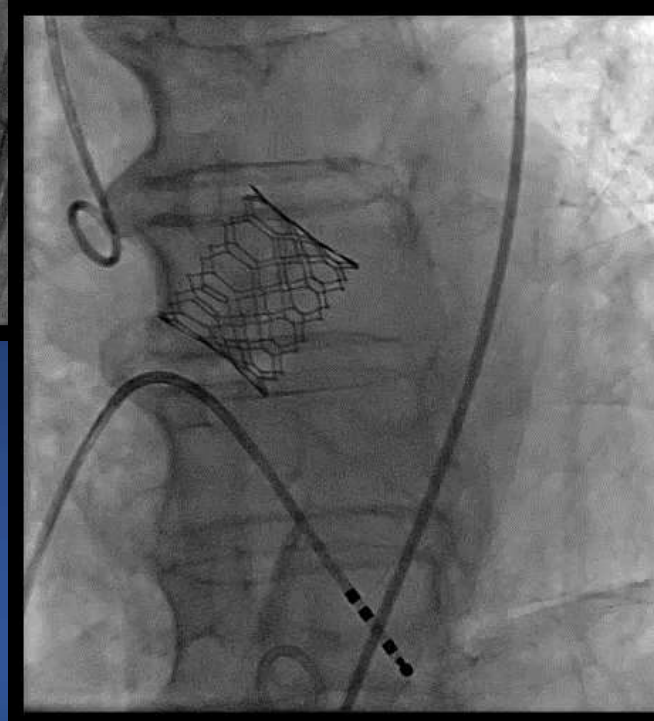
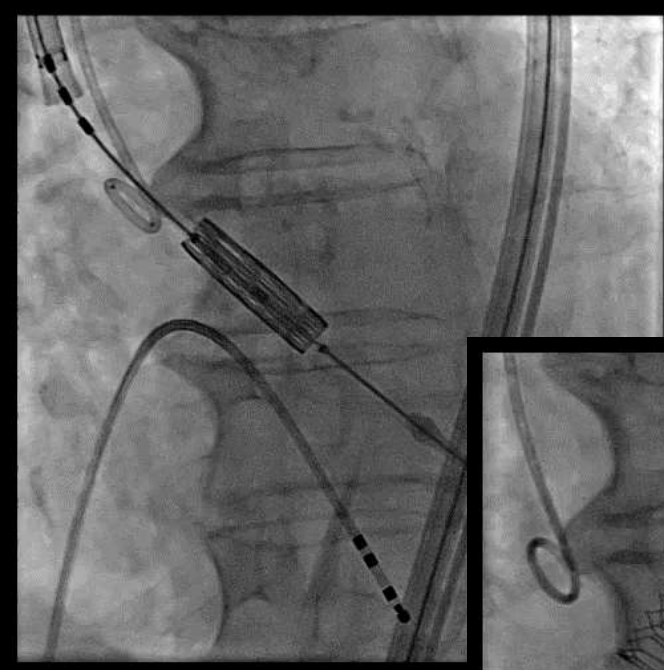
<i>Mild Calcification (Ca volume < 400 mm³)</i>	<i>10~15%, then Overfill</i>
<i>Moderate Calcification (Ca volume 400-1000 mm³)</i>	<i>5~10%, then Overfill</i>
<i>Severe Calcification (Ca volume > 1000 mm³)</i>	<i>0~5%, then Overfill</i>
<i>Bicuspid AS and Heavy Calcification</i>	<i>0%, then Overfill</i>

I choose S3 26mm and 1cc Underfill

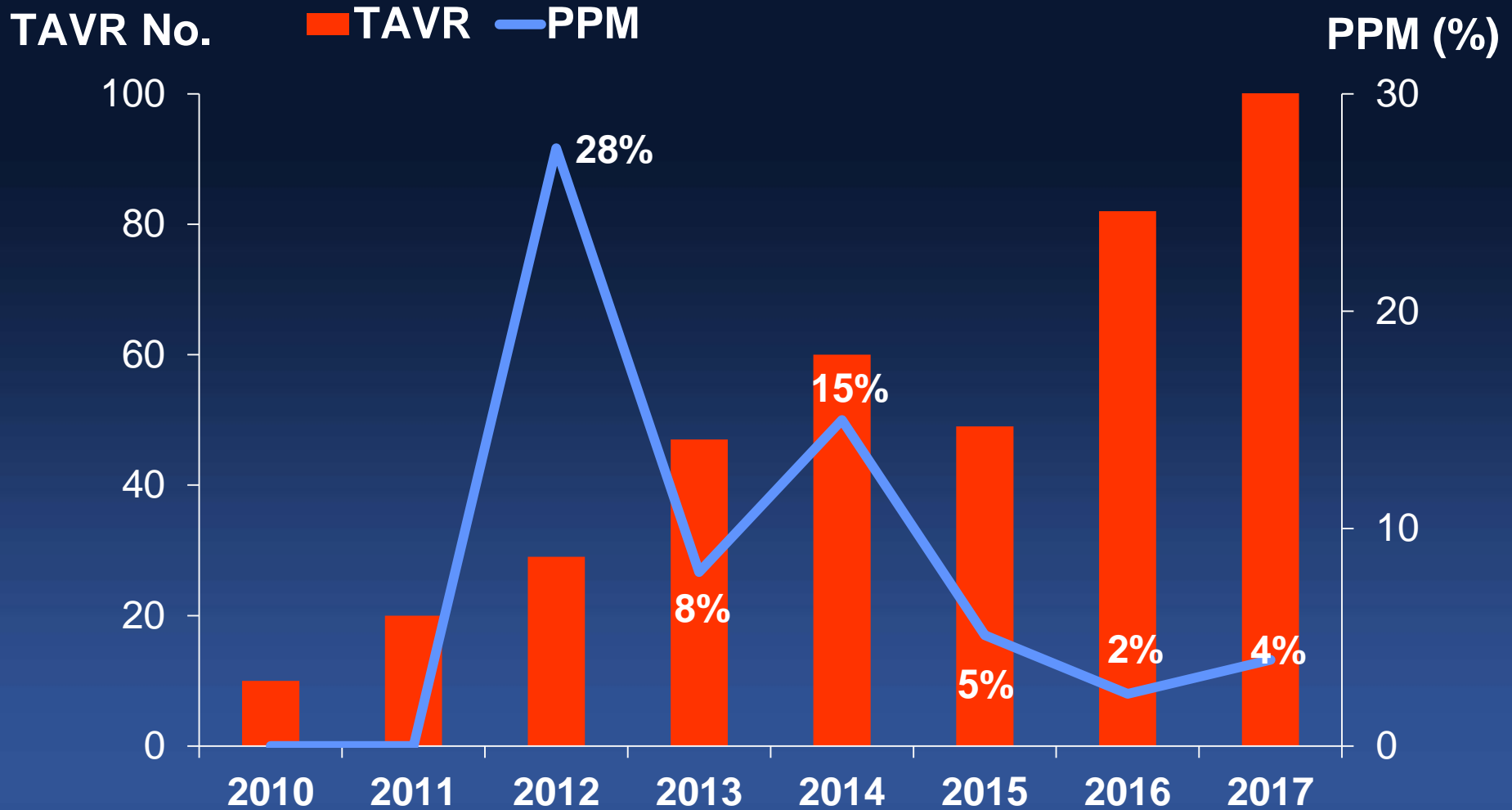
Size	Area_oversize (%)	Perimeter_oversize (%)
23	94.0	95.9
24	102.4	100.1
25	111.1	104.2
26	119.3	108.4
27	128.7	112.6
28	138.4	116.7
29	149.2	121.2

S3 26mm and 1cc Underfill

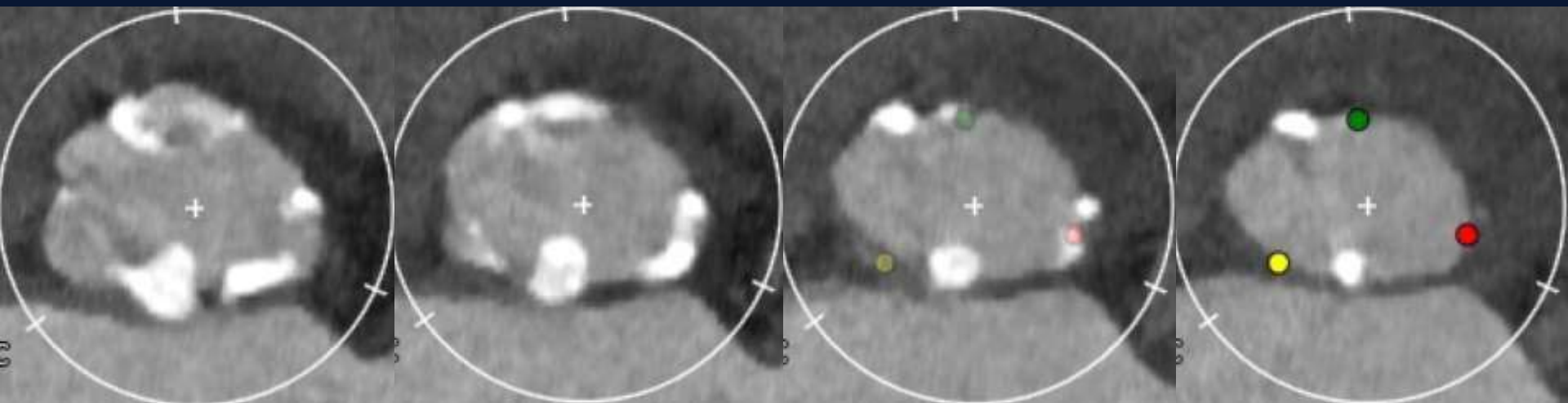
Trivial PVL



PPM After TAVR in AMC



Case #2, 90/M with Severe AS, PCI Hx, AF



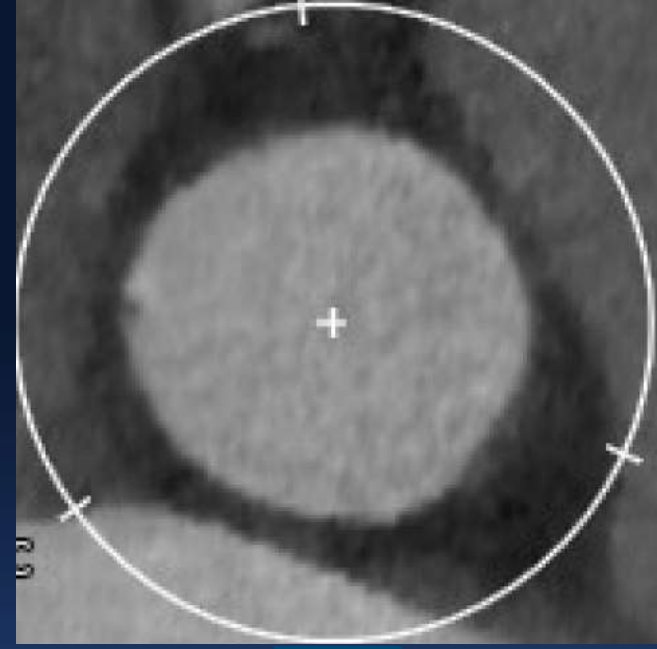
Annulus plane

Aortic Annulus parameters	
Annulus short diameter	20.8 mm
Annulus long diameter	30.8 mm
Annulus mean diameter	25.8 mm
Annulus area	507 mm ²
Annulus area-driven diameter	25.4 mm
Annulus perimeter	82.8 mm
Annulus perimeter-driven diameter	26.3 mm

CT findings – Aortic Valve Complex



Sinus of Valsalva



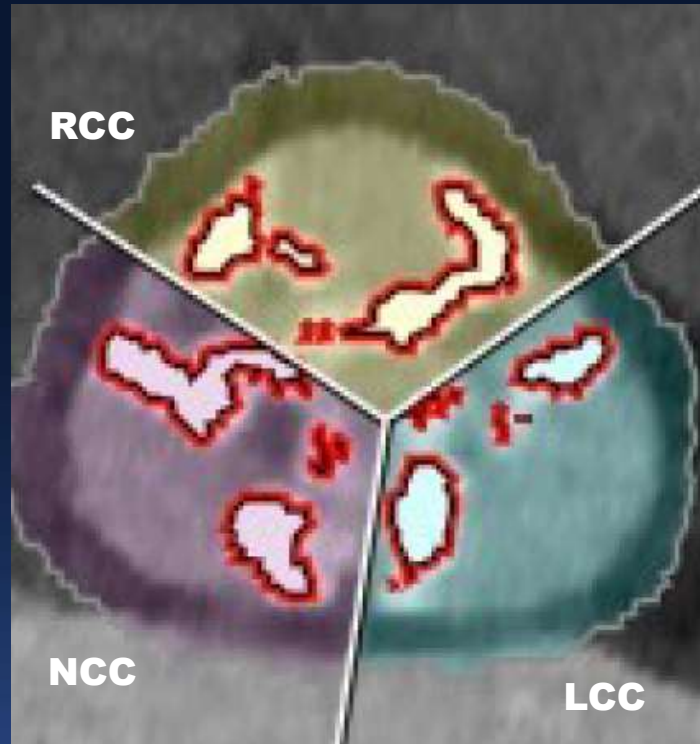
STJ

Sinus of Valsalva		STJ	
Area	927 mm²	Area	750 mm²
Sinus / Annulus Area Ratio	1.83	STJ/ Annulus Area Ratio	1.48
NCC diameter	35.1 mm	Mean diameter	31.0 mm
LCC diameter	36.7 mm	Height of STJ	24.7 mm
RCC diameter	31.8 mm		

Mean Sinus / Annulus Area Ratio **1.83 ± 0.27**

Mean STJ / Annulus Area Ratio **1.49 ± 0.29**

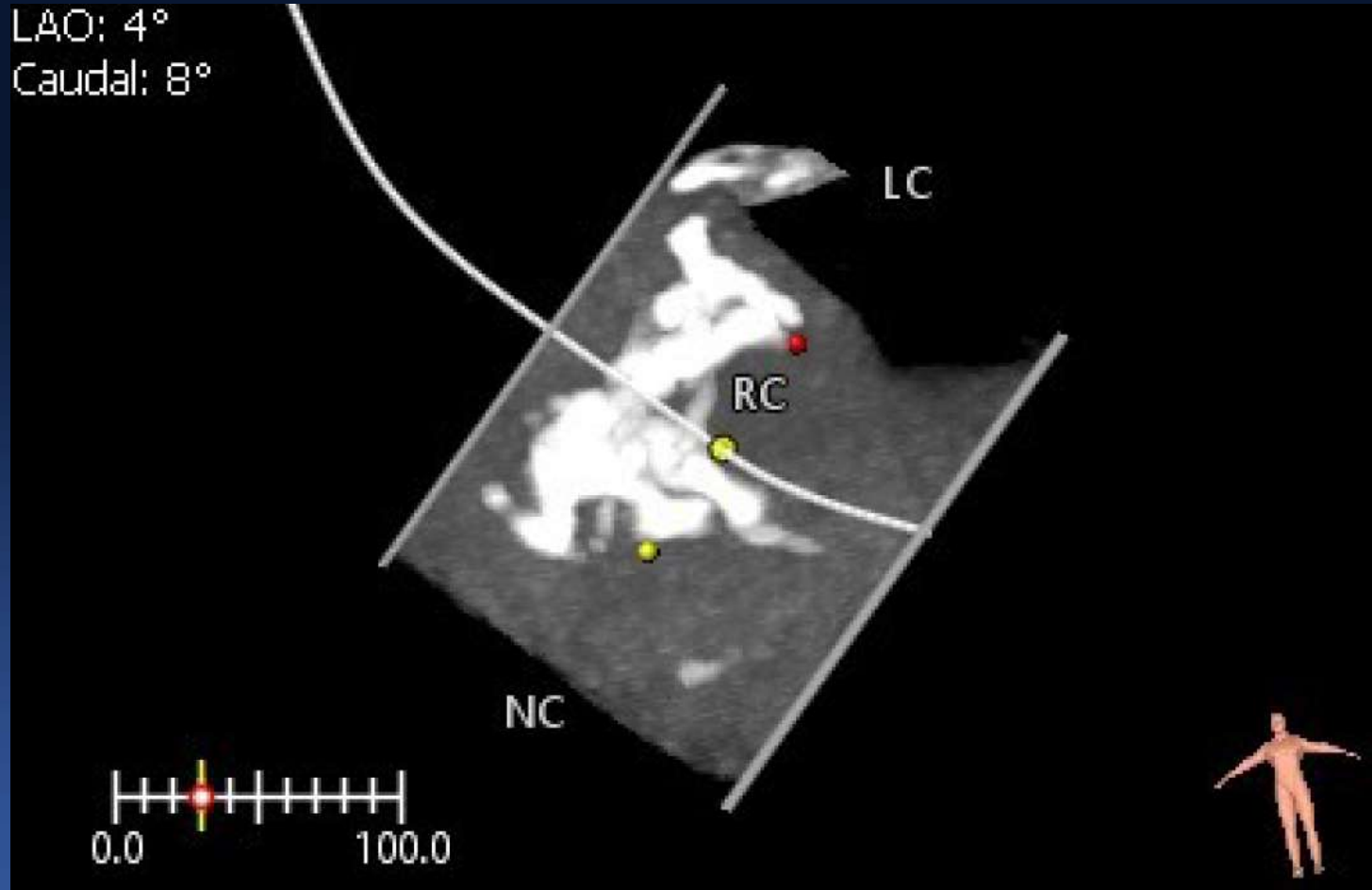
Calcium Amount



Calcium volume	
NCC	723 mm ³
RCC	438 mm ³
LCC	472 mm ³
Total	1633 mm ³

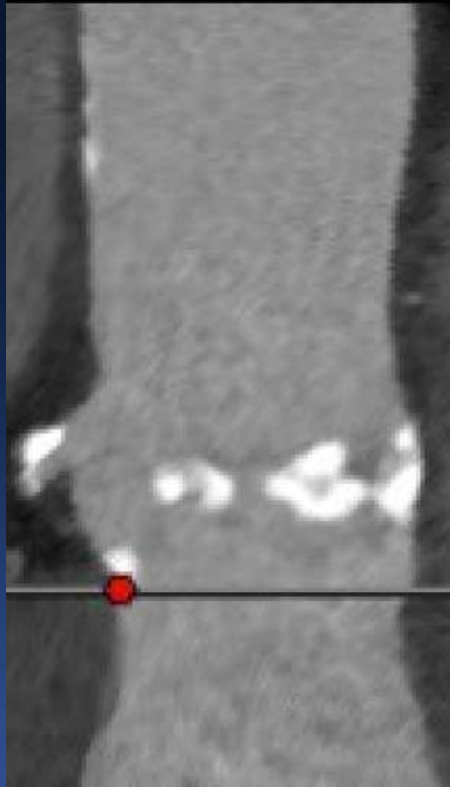
Mean Amount of total Calcium 355.4 ± 289.9

Calcification of AV complex



CT findings – Coronary Height

LCA



RCA



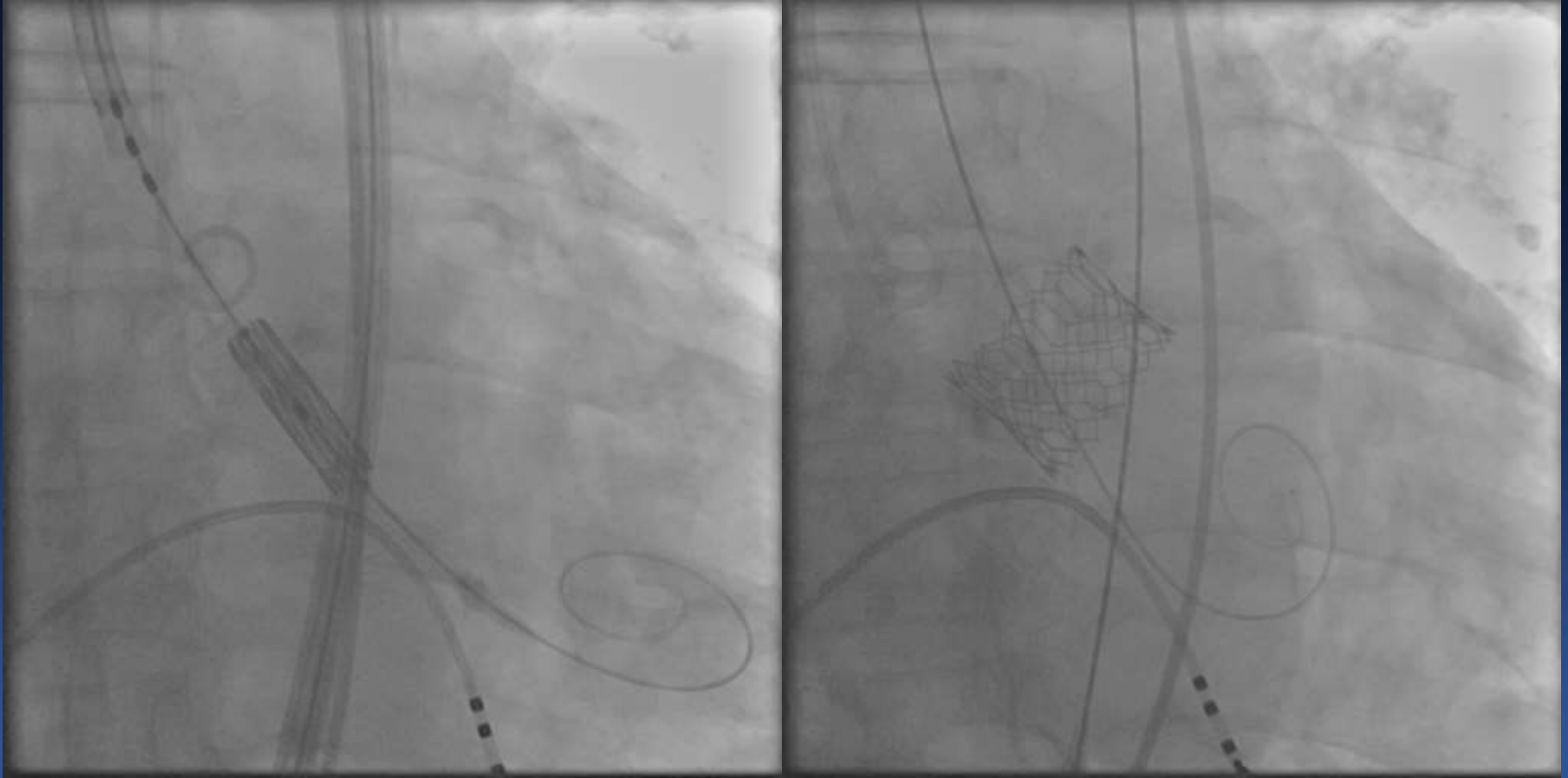
Coronary Height	
LCA	13.5 mm
RCA	17.7 mm

Begin with Smaller Degree of Oversizing

S3 26mm (2.3% Oversizing)

Size	Area_oversize (%)	Perimeter_oversize (%)
24	87.9	90.1
25	95.3	93.8
26	102.3	97.5
27	110.3	101.3
28	118.6	105.0
29	128.0	109.0
30	137.0	112.8

S3 26mm (2.3% Oversizing)



Moderate PVL

Post-dilatation with +2cc Overfill (Upto 27mm, 10% Oversizing)

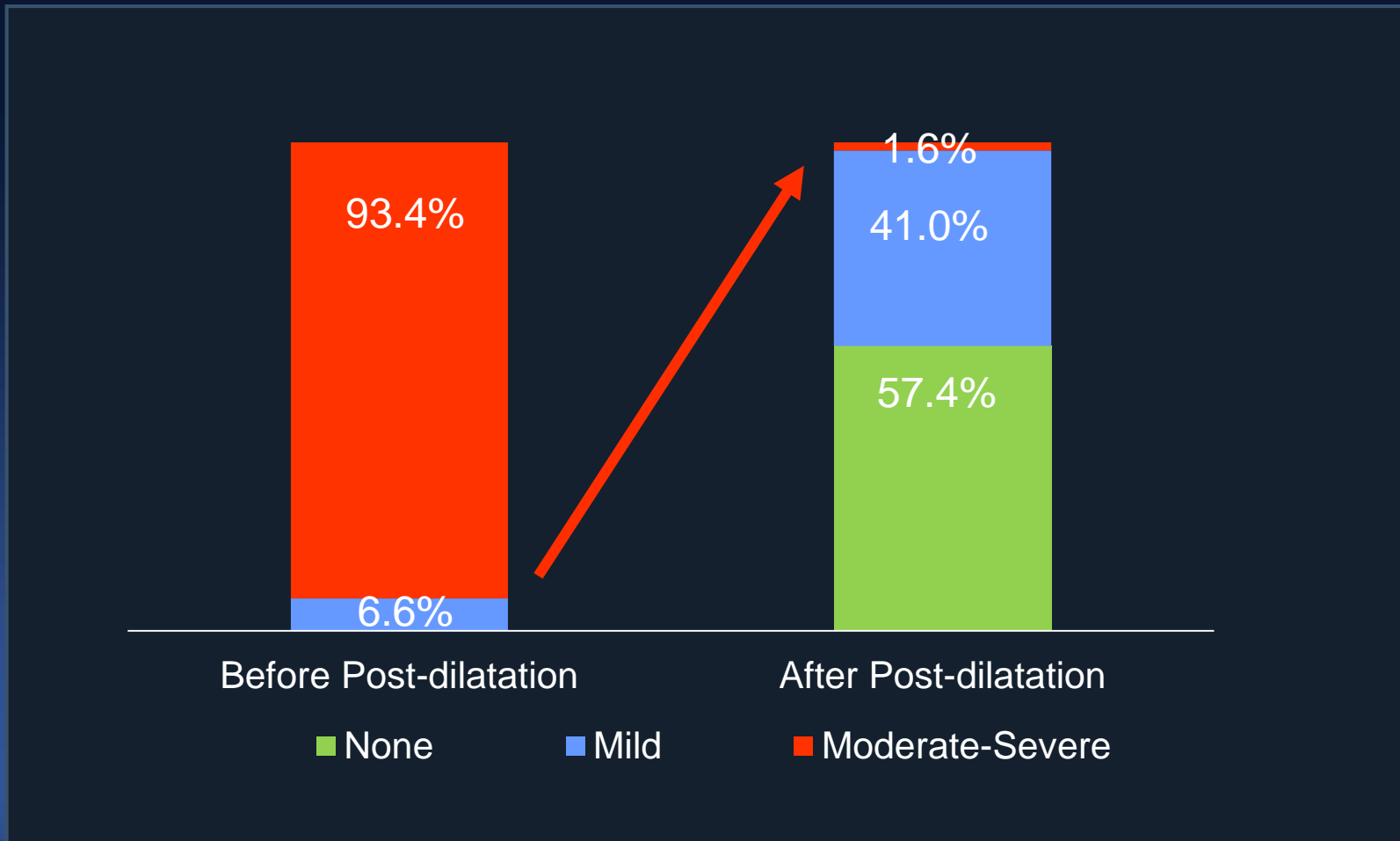
Size	Area_oversize (%)	Perimeter_oversize (%)
24	87.9	90.1
25	95.3	93.8
26	102.3	97.5
27	110.3	101.3
28	118.6	105.0
29	128.0	109.0
30	137.0	112.8

Post-dilation with +2cc Overfill (10% Oversizing)



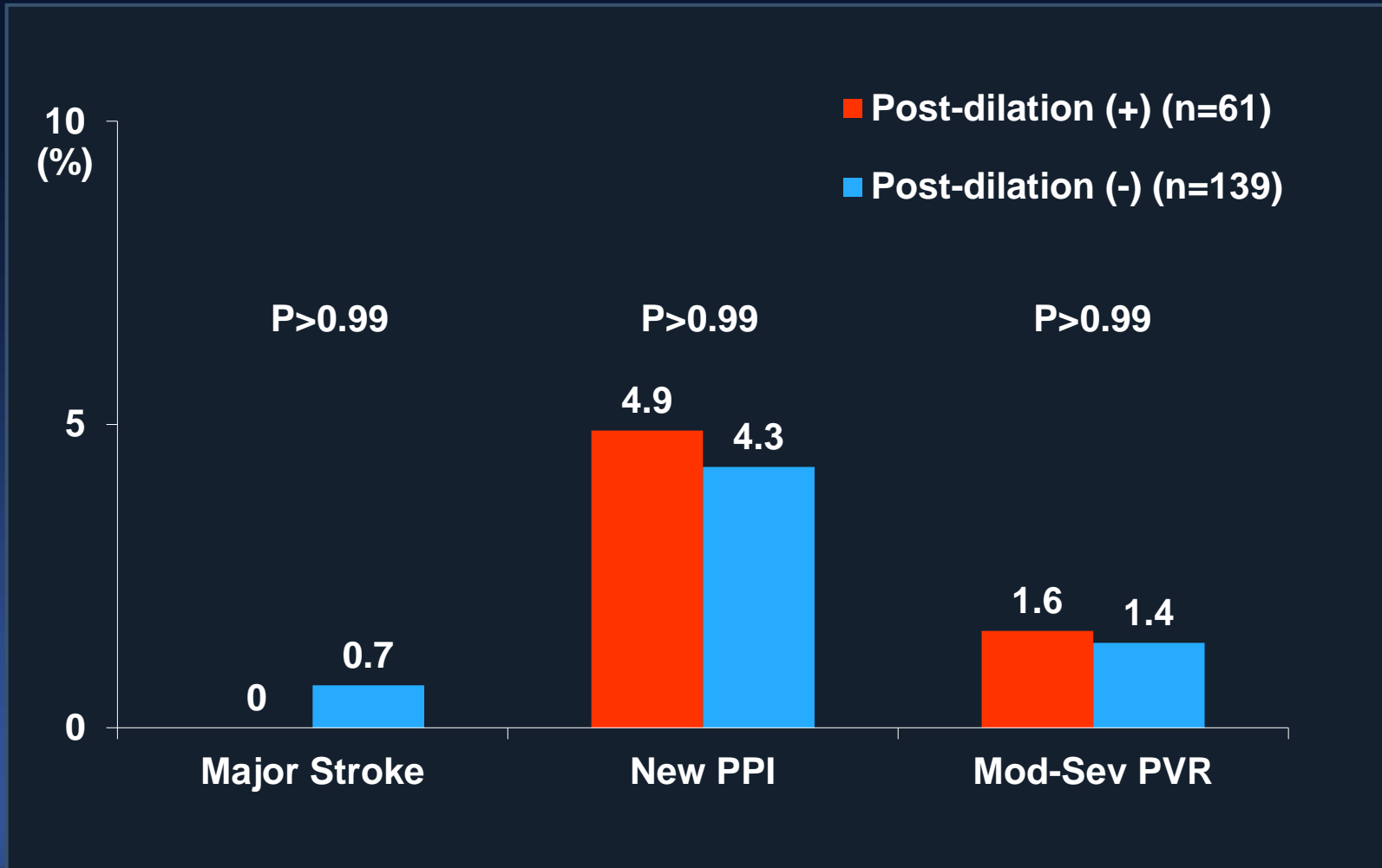
Mild PVL

The impact of Post-Dilatation (n=61)



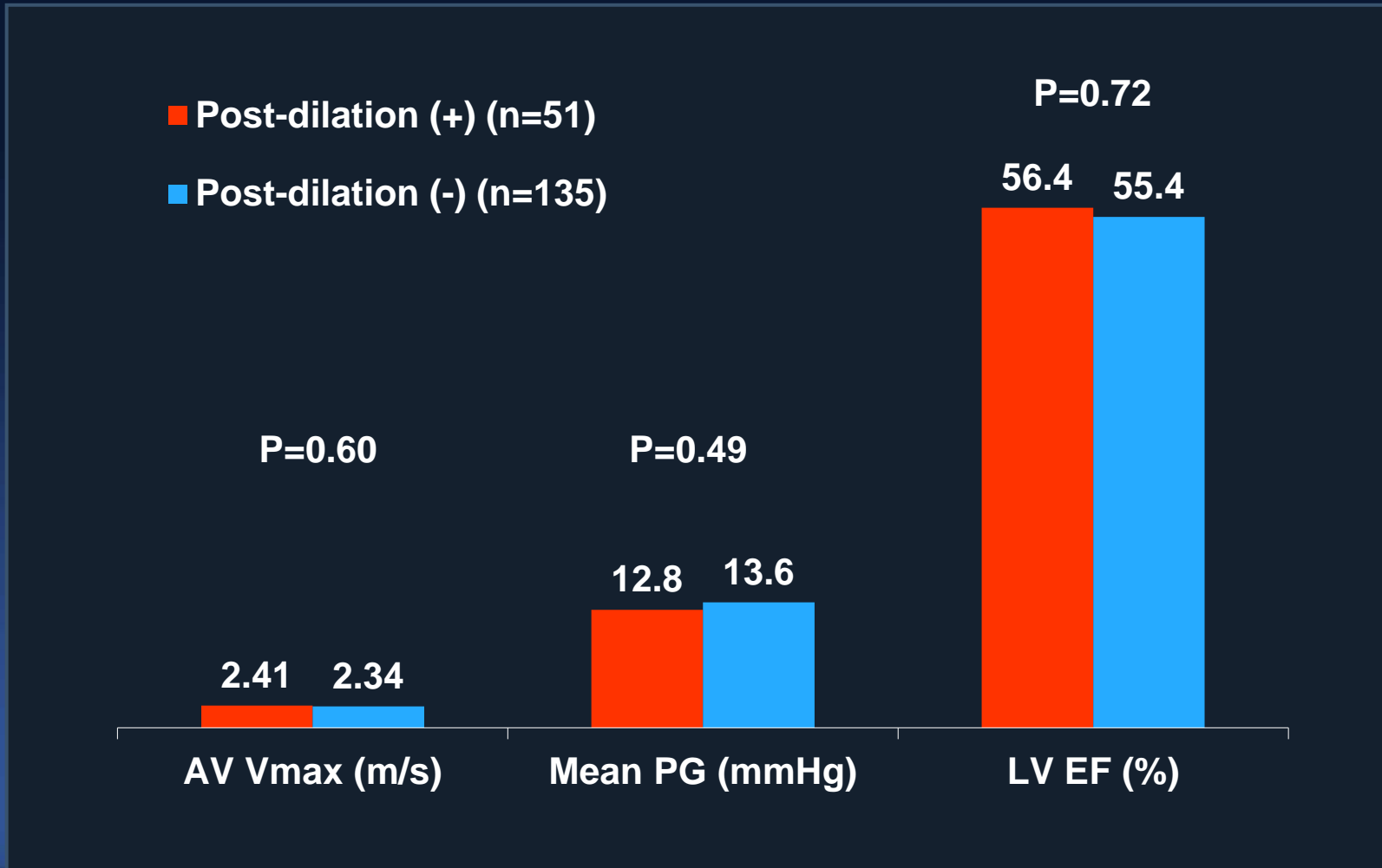
Post-dilation was safe and effective

Clinical Outcomes at 1 month after TAVR

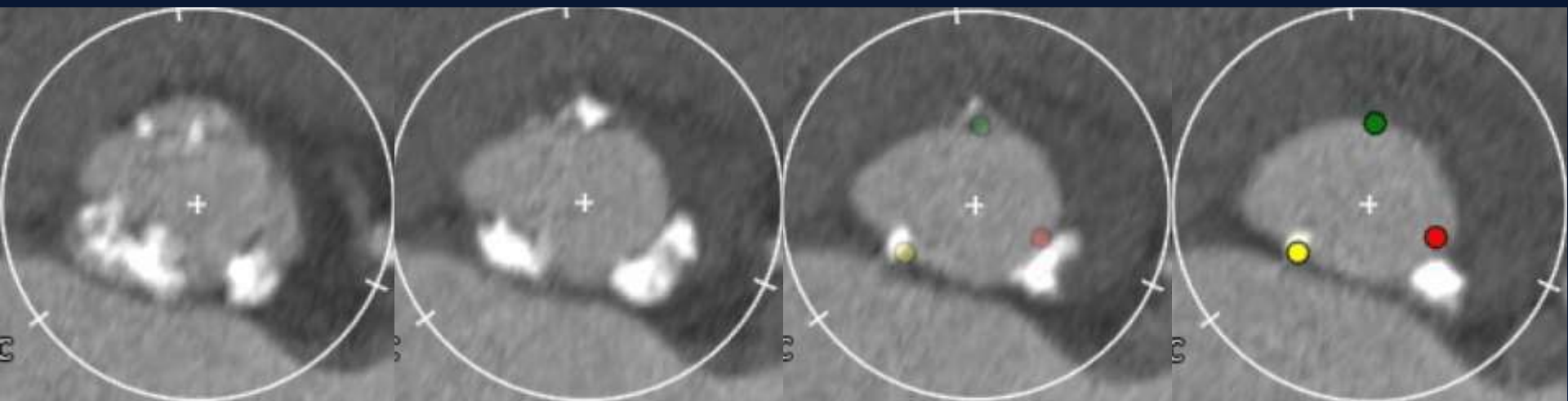


Post-dilation was safe and effective

EchoCG at 1 month after TAVR



Case #3, 86/F with Severe AS, LV dysfunction



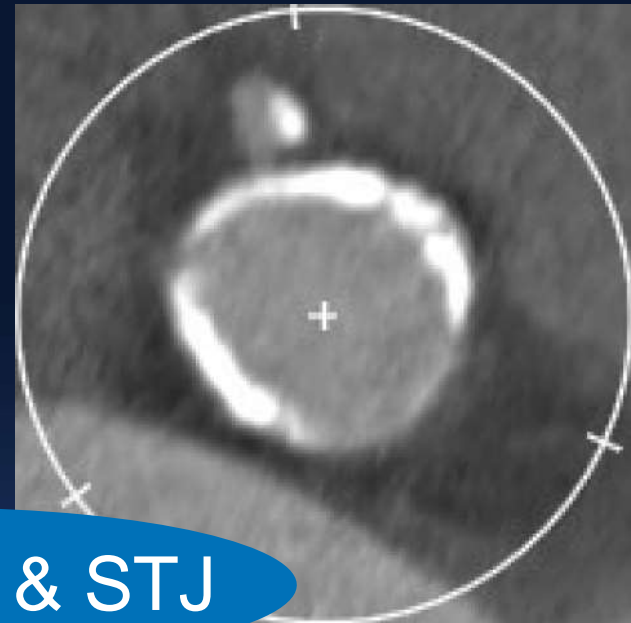
Annulus plane

Aortic Annulus parameters	
Annulus short diameter	20.0 mm
Annulus long diameter	27.1 mm
Annulus mean diameter	23.6 mm
Annulus area	427 mm ²
Annulus area-driven diameter	23.3 mm
Annulus perimeter	75.3 mm
Annulus perimeter-driven diameter	24.0 mm

CT findings – Aortic Valve Complex



Sinus of Valsalva



STJ

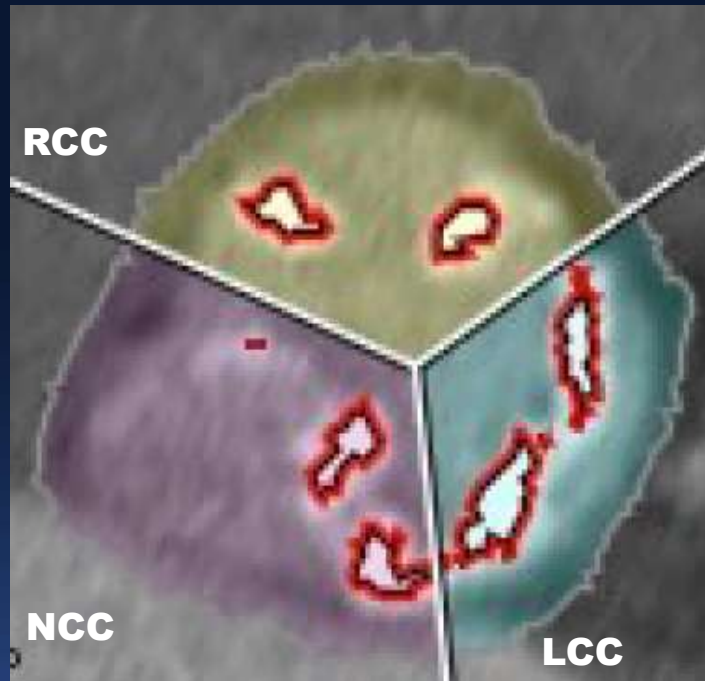
Small SoV & STJ

Sinus of Valsalva		STJ	
Area	691 mm ²	Area	399 mm ²
Sinus / Annulus Area Ratio	1.62	STJ/ Annulus Area Ratio	0.93
NCC diameter	31.2 mm	Mean diameter	22.7 mm
LCC diameter	28.7 mm	Height of STJ	20.8 mm
RCC diameter	27.8 mm		

Mean Sinus / Annulus Area Ratio 1.83 ± 0.27

Mean STJ / Annulus Area Ratio 1.49 ± 0.29

Calcium Amount

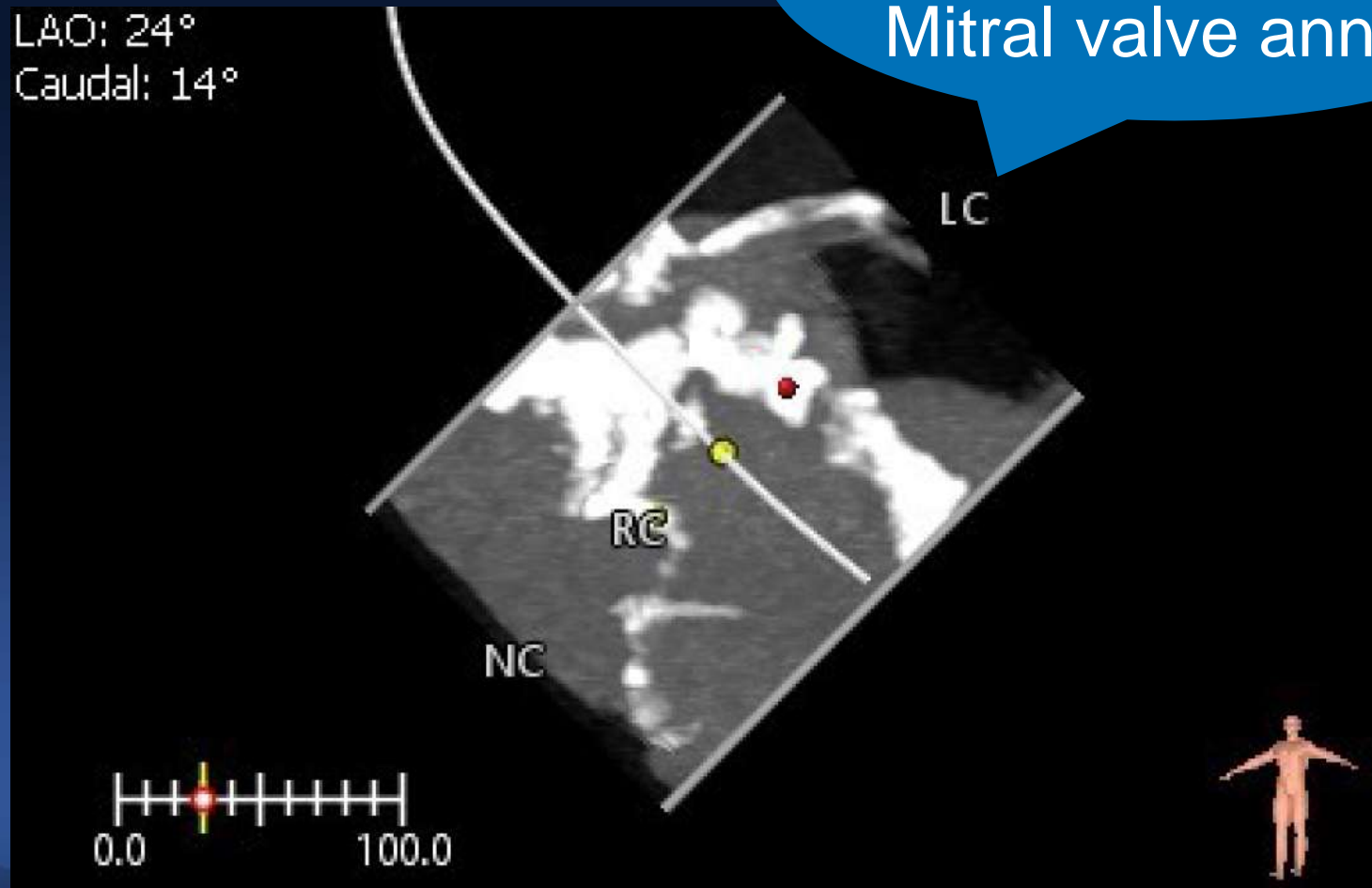


Calcium volume	
NCC	420 mm ³
RCC	234 mm ³
LCC	322 mm ³
Total	976 mm ³

Mean Amount of total Calcium 355.4 ± 289.9

CT findings – AV complex Calcification

Heavy Calcification extended to LVOT & Mitral valve annulus

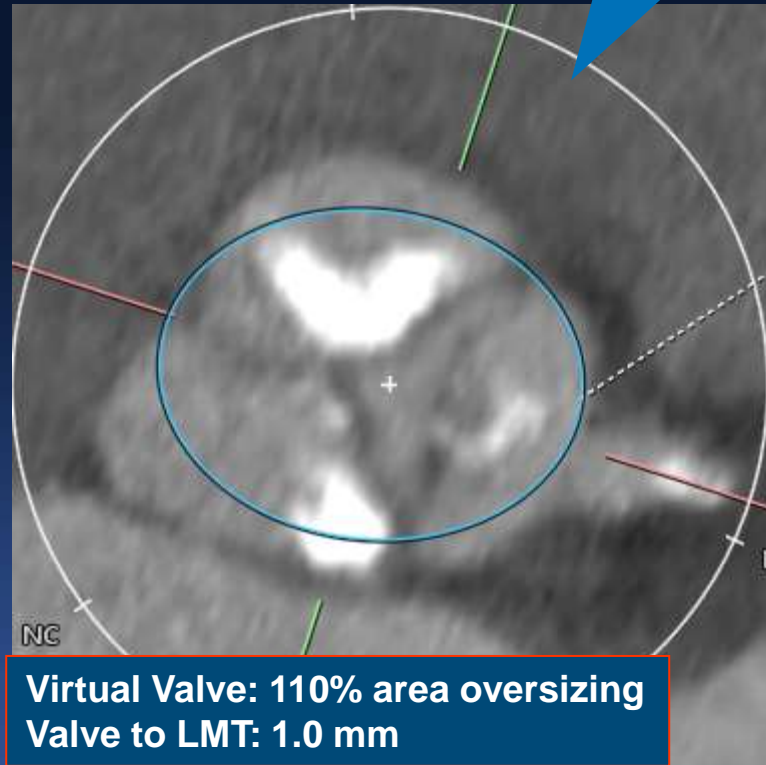


High Risk of Coronary Obstruction

Small SoV

LCA

RCA



Low coronary height with long LCC leaflet

Coronary Height	
LCA	10.0 mm
RCA	17.5 mm

High Anatomic Risk for TAVR !!!

Heavy Calcification

Small SoV

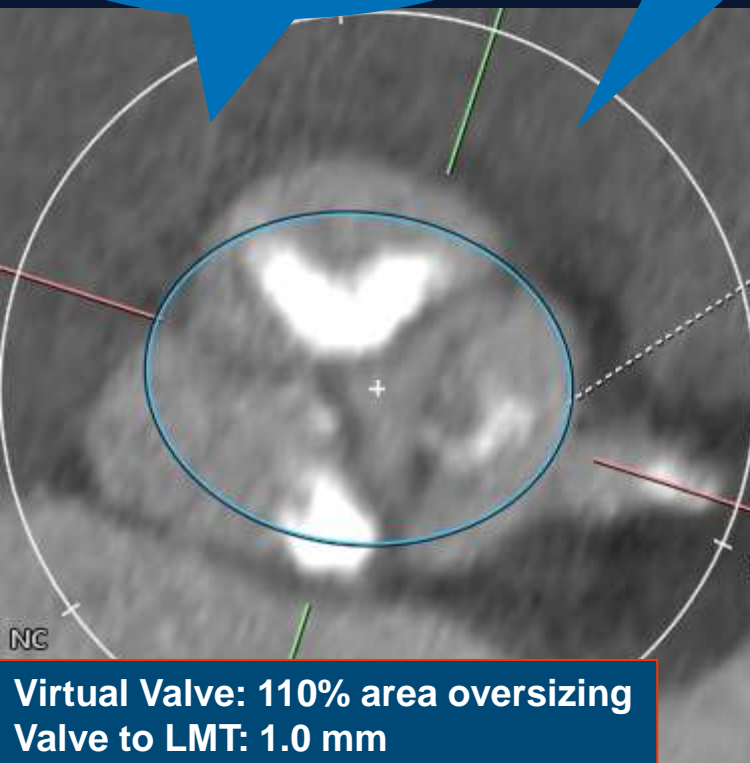
LCA

RCA



Length of LCC: 16.4 mm

Coronary Height	
LCA	10.0 mm
RCA	17.5 mm



Virtual Valve: 110% area oversizing
Valve to LMT: 1.0 mm

Low coronary height with long LCC leaflet

**86/F,
Severe AS, LV dysfunction (EF 38%),
Parkinsonism
STS score 4.5%**

CT Anatomy can Guide to Select Optimal Candidate for TAVR vs. SAVR

→ Successful Rapid-Deployment AVR was done.

Case #4, M/79 with Bicuspid AS



Annulus plane

Aortic Annulus parameters	
Annulus short diameter	26.0 mm
Annulus long diameter	28.6 mm
Annulus mean diameter	27.3 mm
Annulus area	589 mm ²
Annulus area-driven diameter	27.4 mm
Annulus perimeter	86.5 mm
Annulus perimeter-driven diameter	27.5 mm

Calcium Amount

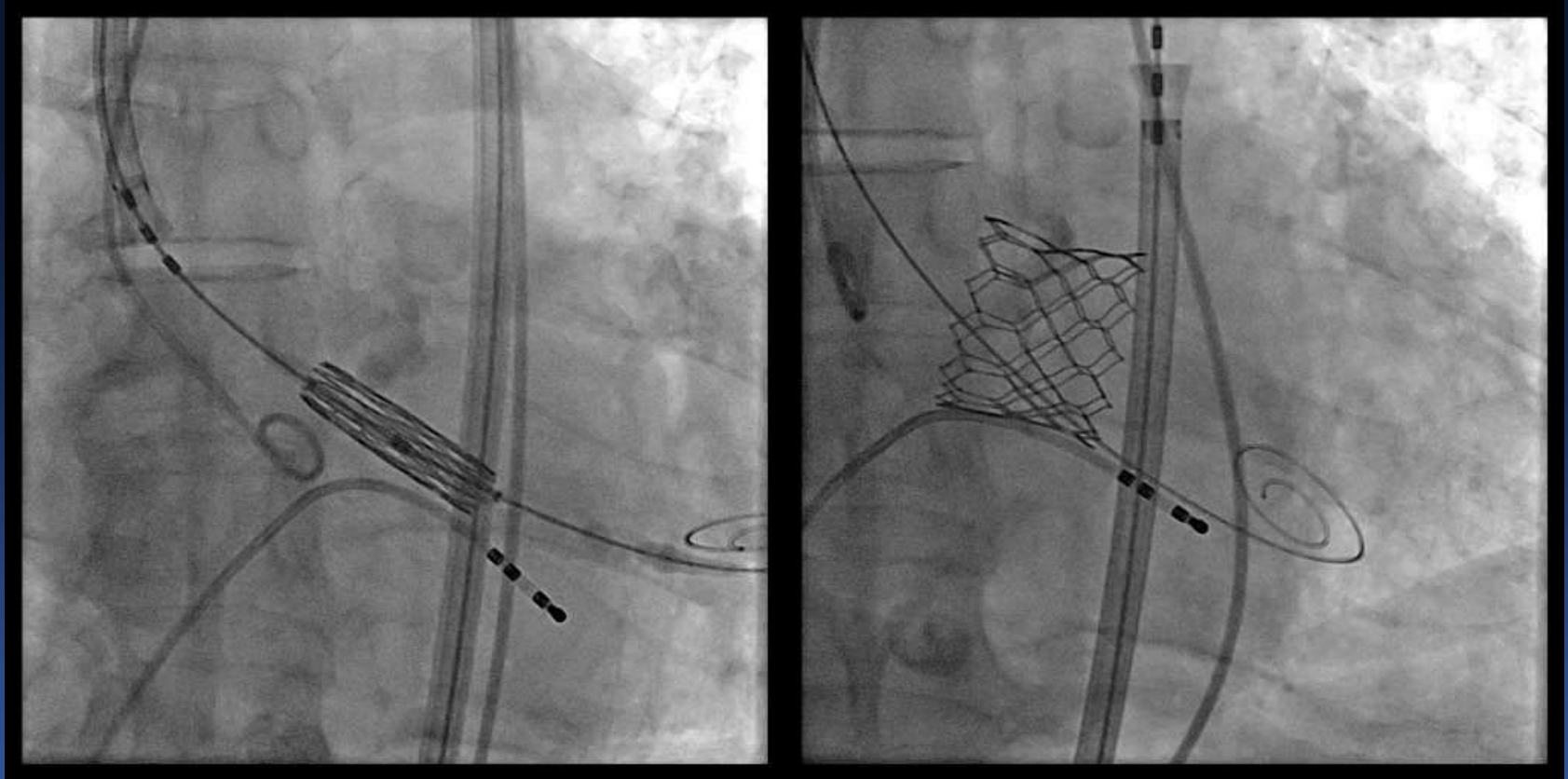


Calcium volume	
RCC	616 mm ³
LCC	48 mm ³
Total	664 mm ³

S3 29mm with -3cc Underfill (2% Oversizing)

Size	Area_oversize (%)	Perimeter_oversize (%)
24	75.6	86.2
25	82.0	89.8
26	88.1	93.3
27	95.0	96.9
28	102.2	100.5
29	110.2	104.4
30	117.9	108.0

S3 29mm with -3cc Underfill (2% Oversizing)

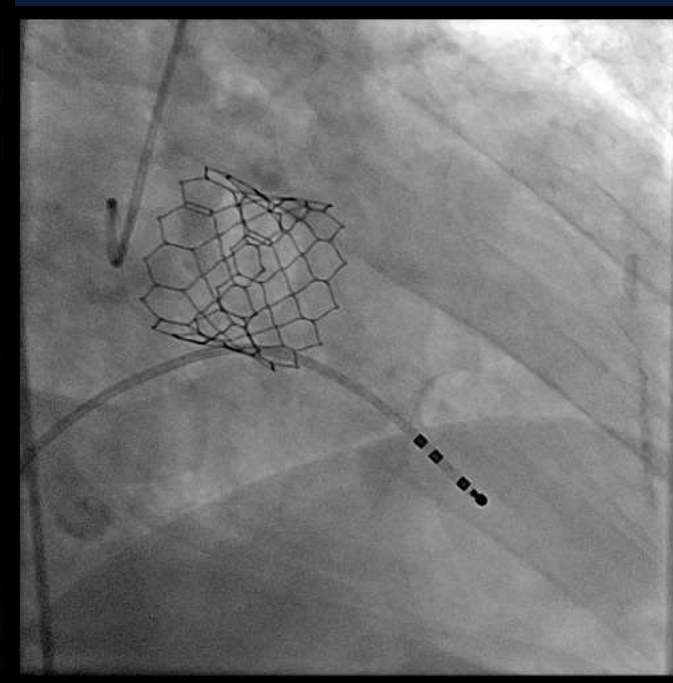
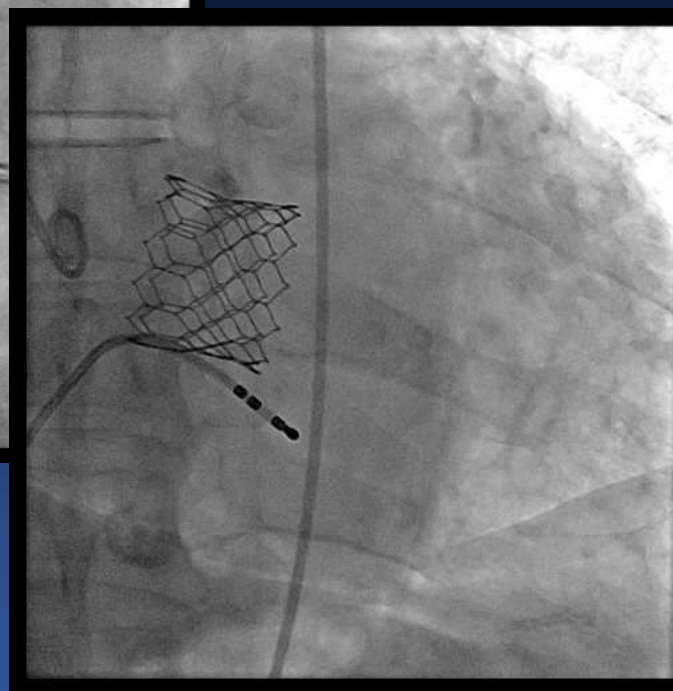
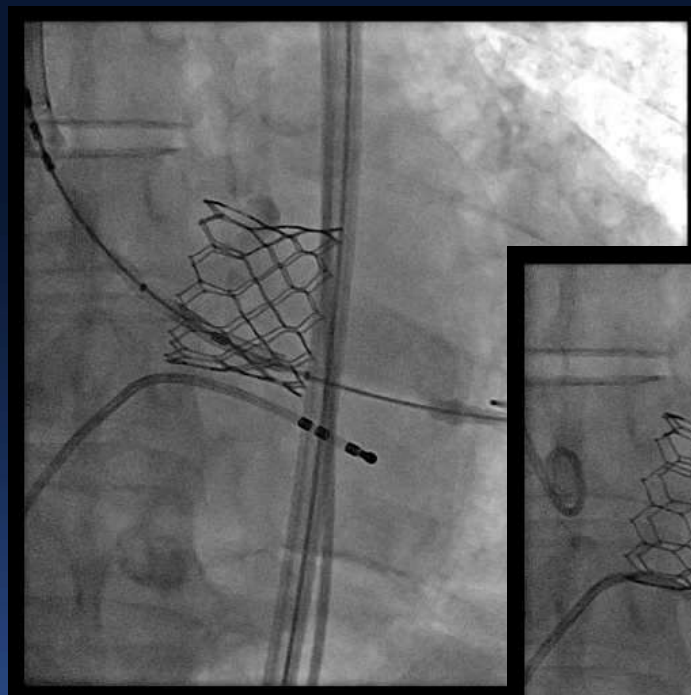


Moderate PVL

Post-dilation with +3cc (nominal volume) (10% Oversizing)

Size	Area_oversize (%)	Perimeter_oversize (%)
24	75.6	86.2
25	82.0	89.8
26	88.1	93.3
27	95.0	96.9
28	102.2	100.5
29	110.2	104.4
30	117.9	108.0

Post-dilation with +3cc (nominal volume) (10% Oversizing)



Mild PVL

Outcomes after TAVR in AMC

Outcomes of PARTNER III for Low-Risk AS patients (@ 30 days)

- All-cause mortality 0.4%
- Major (disabling) strokes 0.0%
- Major vascular complications 2.2%
- New permanent pacemakers 6.6%
- Mod-severe PVR 0.8%

	AMC Total (n=533)	S3 Tricuspid (n=211)	S3 Low Risk (n=141)
All-cause mortality	2.6%	1.9%	0.2%
Major (disabling) strokes	1.5%	0.5%	0%
Major vascular complications	4.5%	1.9%	0.3%
New permanent pacemakers	8.4%	5.7%	4.9%
Mod-severe PVR	8.6%	1.4%	1.4%

STS

1.9%

4.3%

3.7%

2.6%

Conclusion

- Anatomic risk evaluation is important, especially in the era of TAVR for patients with lower surgical risk.
- Optimal patient and valve selection by comprehensive MDCT analysis is essential to optimize the procedural outcomes.
- CT sizing algorithm with provisional post-dilation upto intended target oversizing ratio is safe and effective.