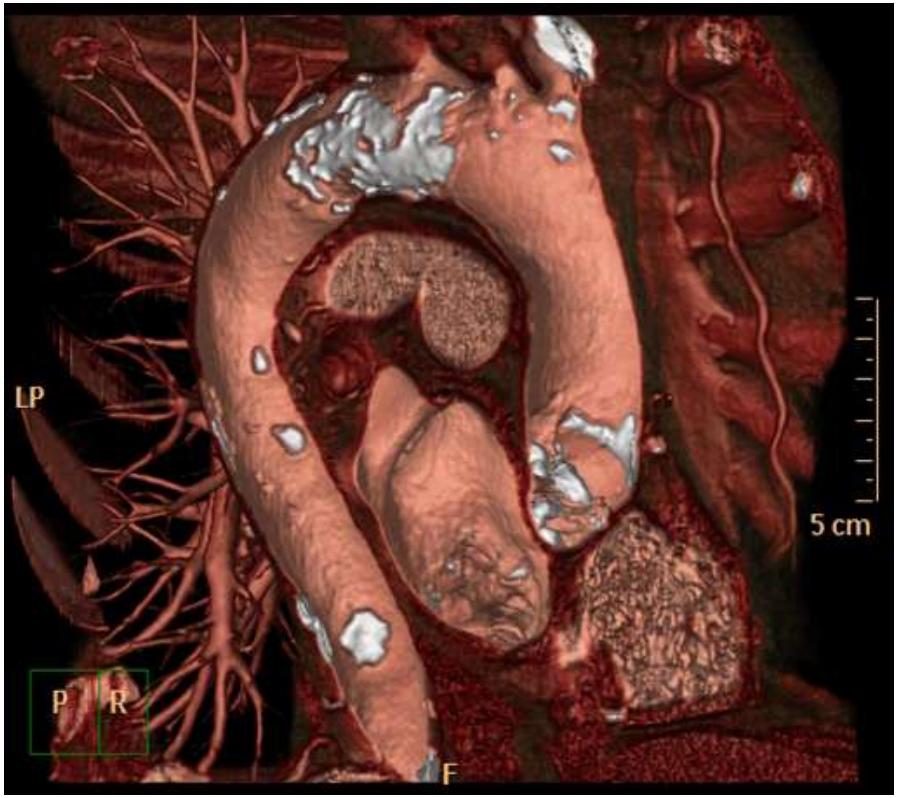
# Aortic MSCT for TAVI assessment

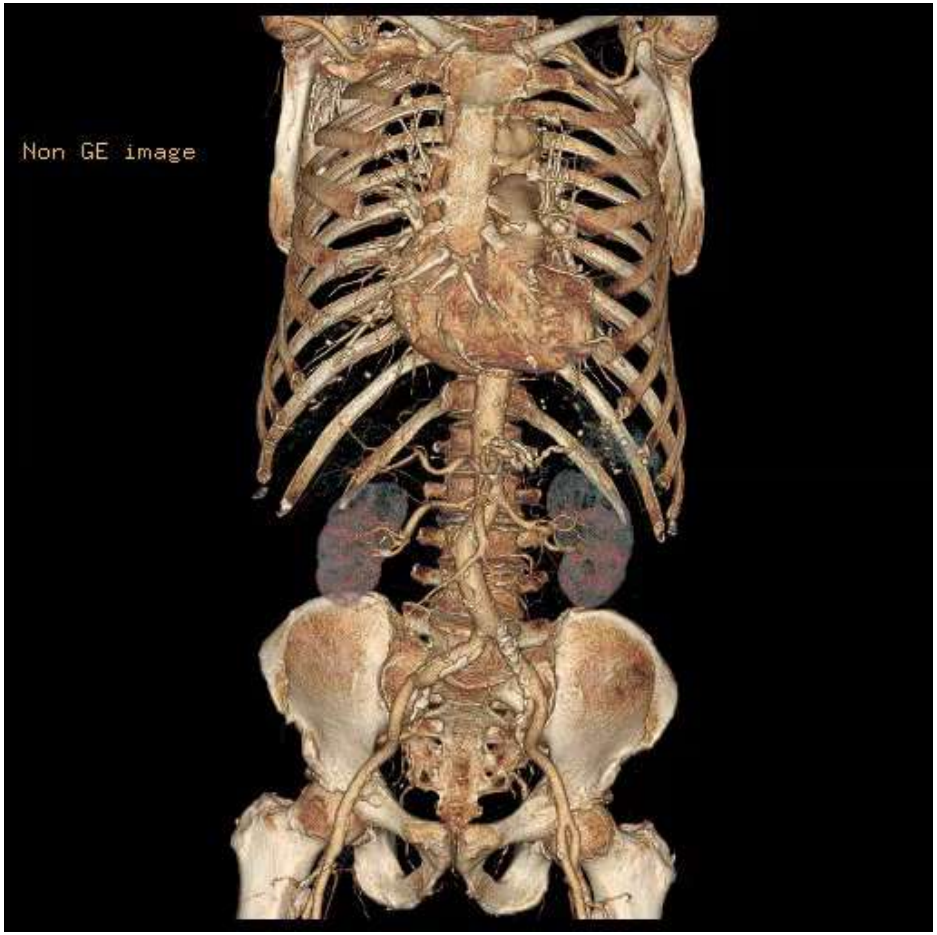



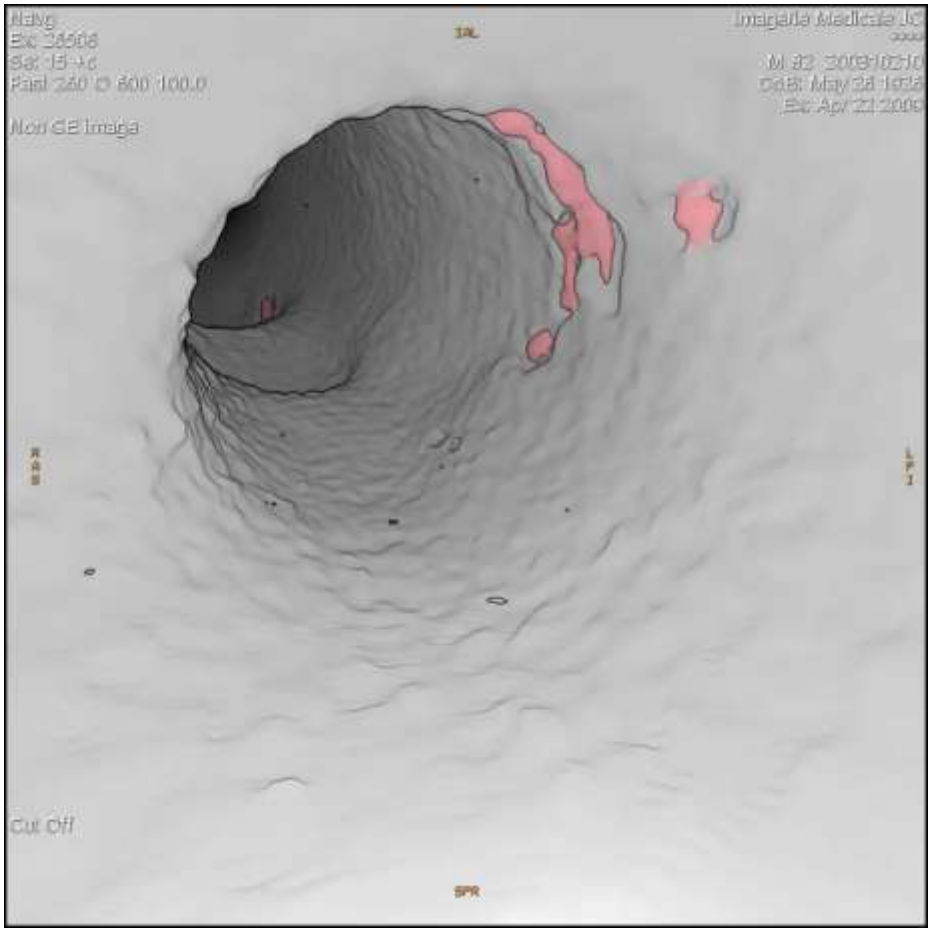

Bernard Chevalier on behalf of ICPS team, Massy, FR

- In the last five years , I received  research grants or speaker fees or I am/was consultant for: Abbott Vascular, Asahi, Astra Zeneca, AVI, Boston Scientific, Biotronik, Colibri, Cook, Cordis, Daichi-Sankyo, Eli-Lilly, Iroko, Medtronic, Terumo. I am currently minor shareholder & general director of CERC (CRO)

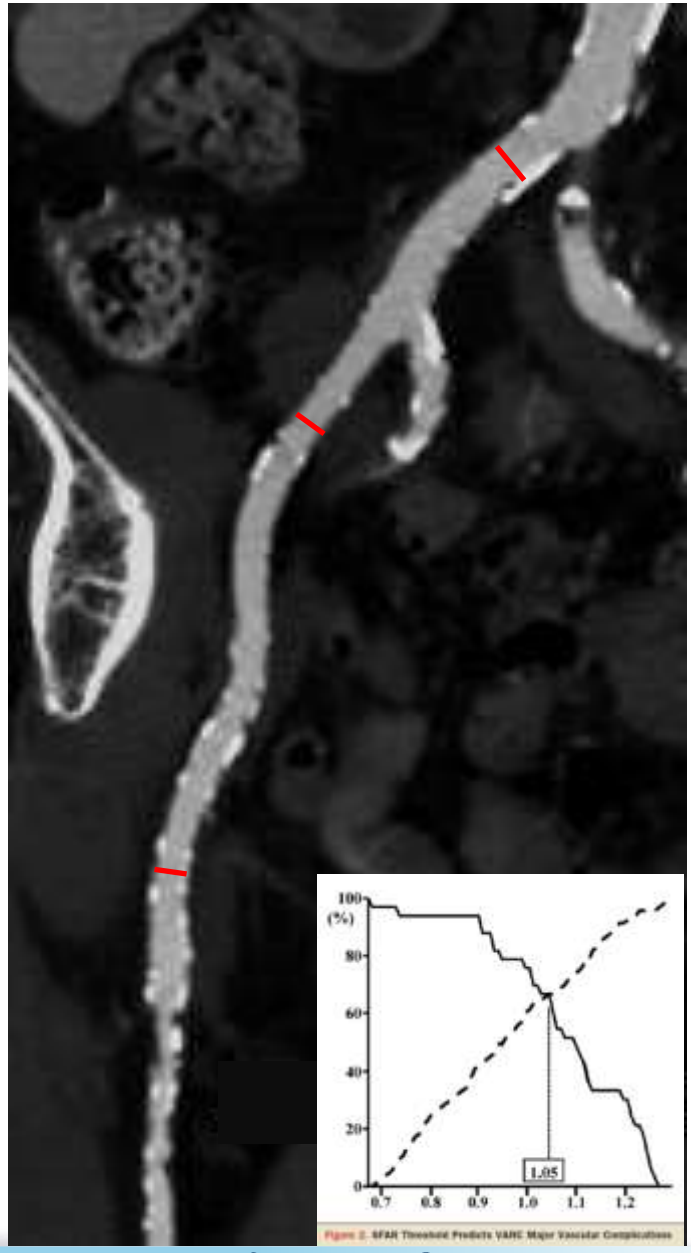
# Before TAVI

# Vascular access



# Ilio-femoral Vessels for Vascular Access




**MIP projection and 3D VR :**
- vessel sinuosities & angles

**Curvilinear MPR** : lumen analysis
- vessel diameter
- soft plaque or calcified atheroma
- stenosis quantification

**Calcifications** are always overestimated with current CT technology
= lumen underestimated

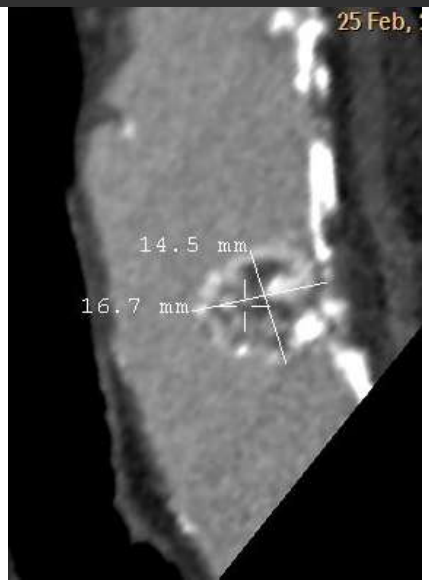
**Soft plaques** are reliably estimated

**Thresholds** :
- > 6.5 mm minimal vessel diameter / lumen
- < 180° circumferential calcification
- < 1.05 sheath/femoral artery ratio
- < 90° angulation



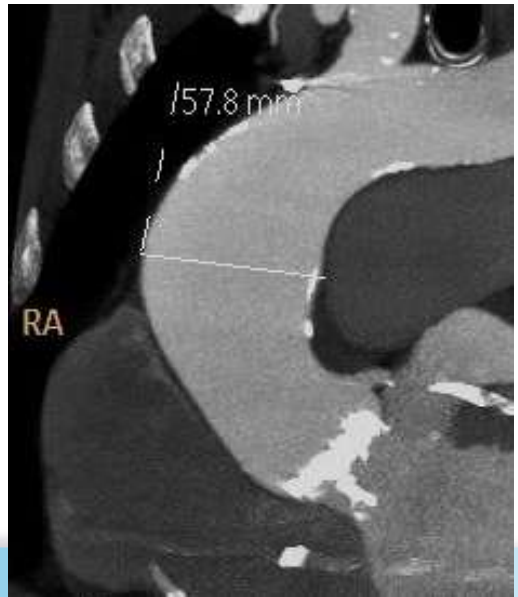
Hayashida & al (Massy). JACC Cardiov Interv 2011;4:851-8

# Aorta

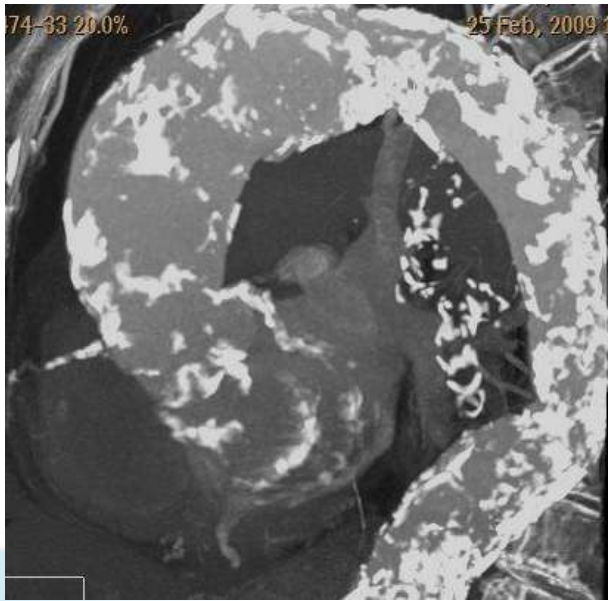





Diameters

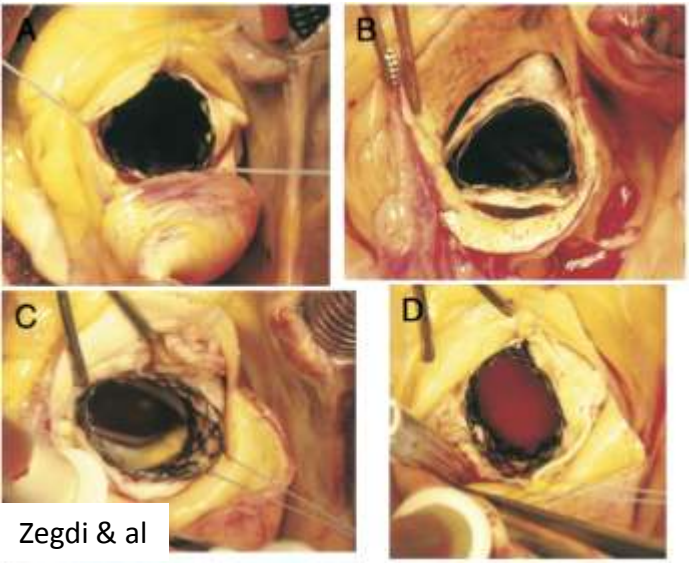



Atheroma

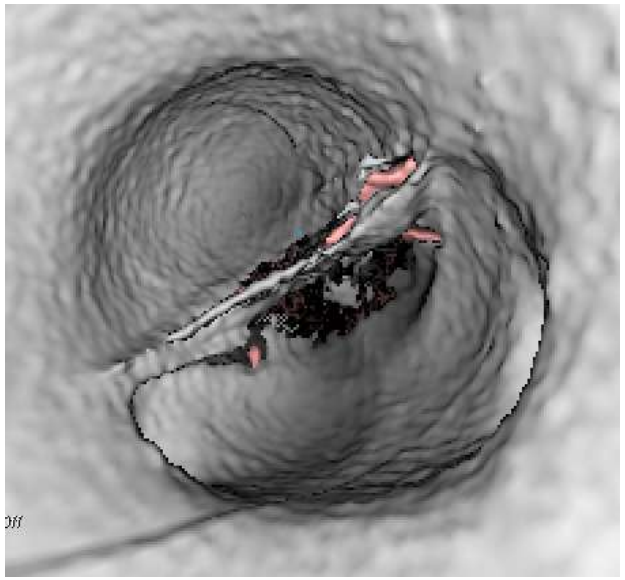


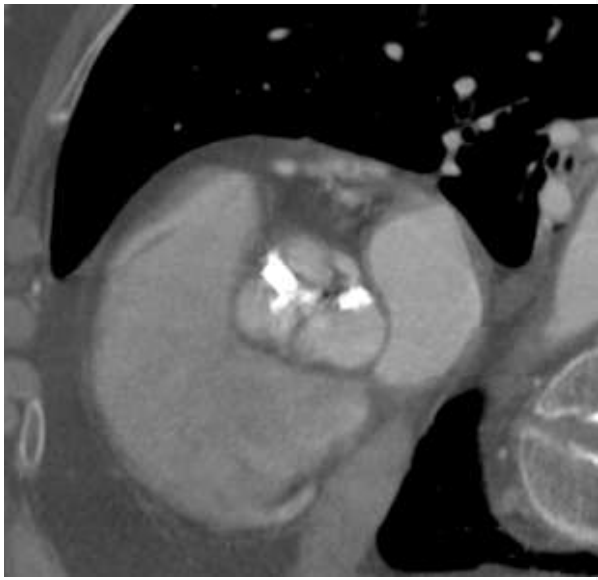

Sinuosity

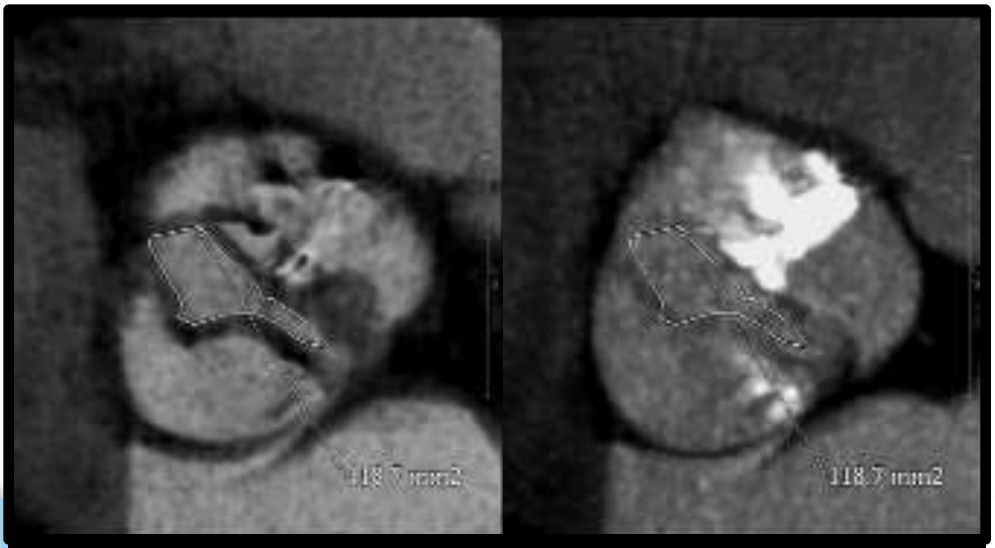
# Bicuspid Aortic Valve

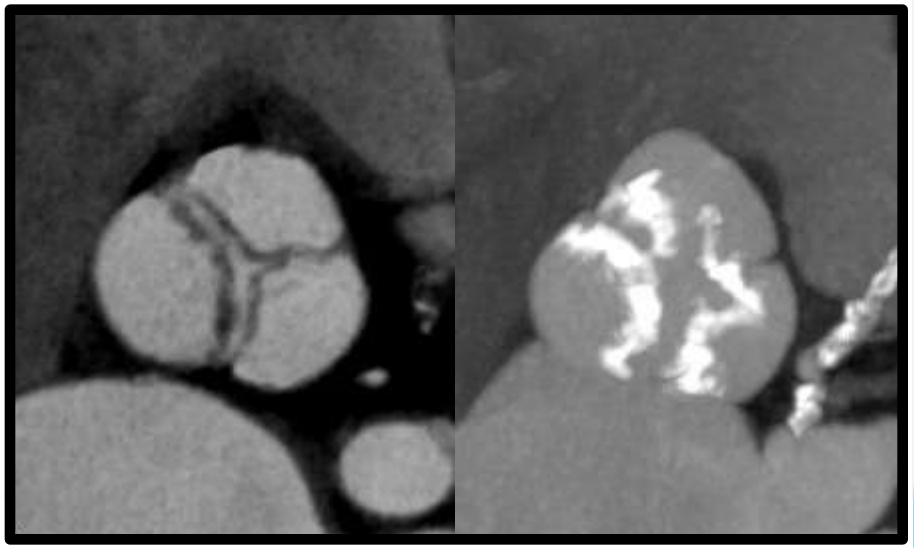



Zegdi & al



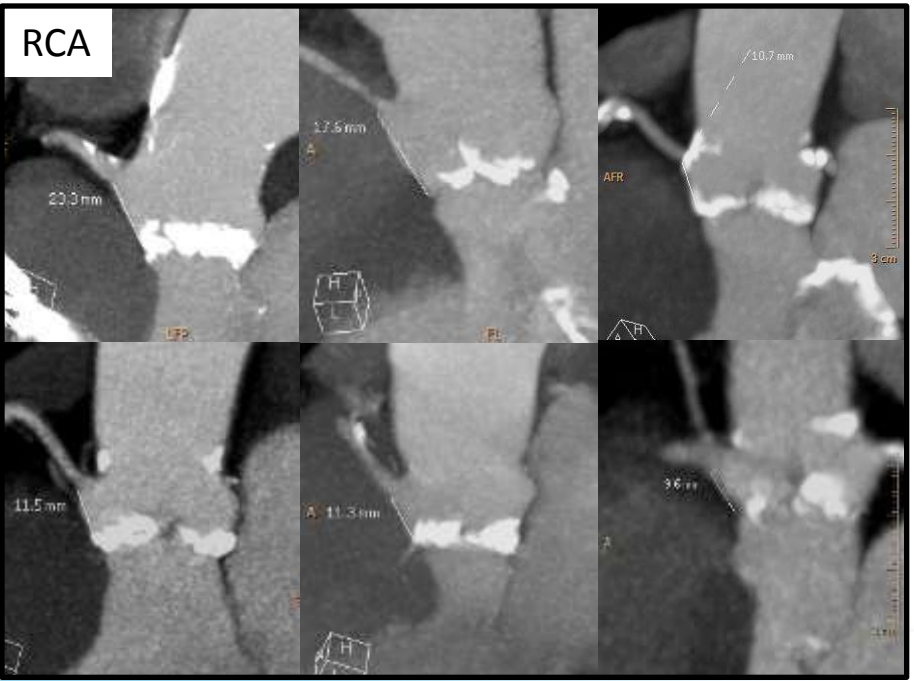


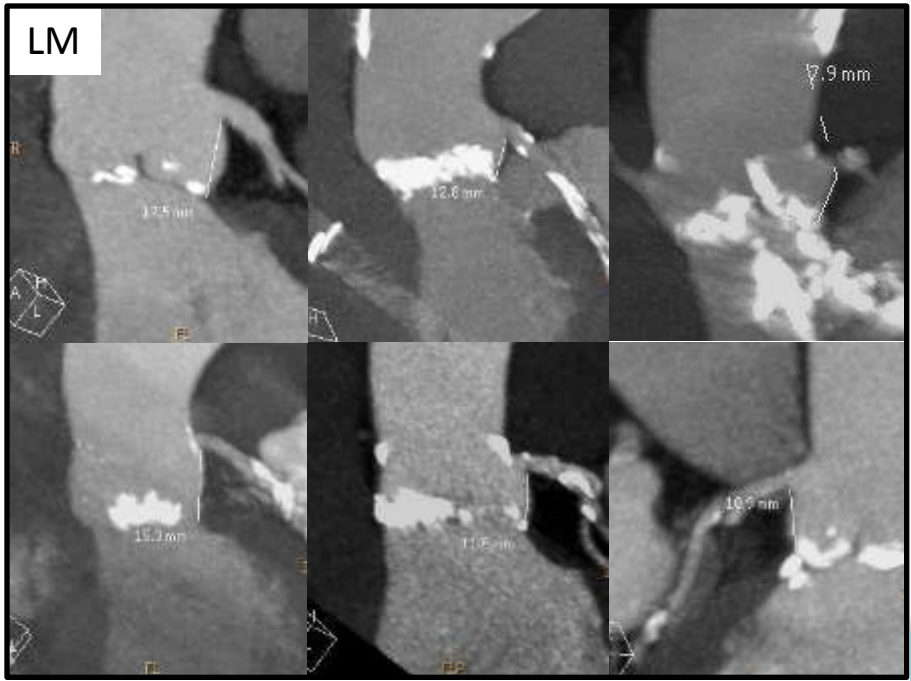




# Coronary ostia


- High variability of height and location in sinus
- Interaction with
  * Sinus width
  * Cusp length
  * Calcifications on the aortic cusp edge
- Occlusion seldom happens despite frequent overlap with cusp
- Which thresholds to use ? Height > 12 mm



# Annulus size

**Very important information:**

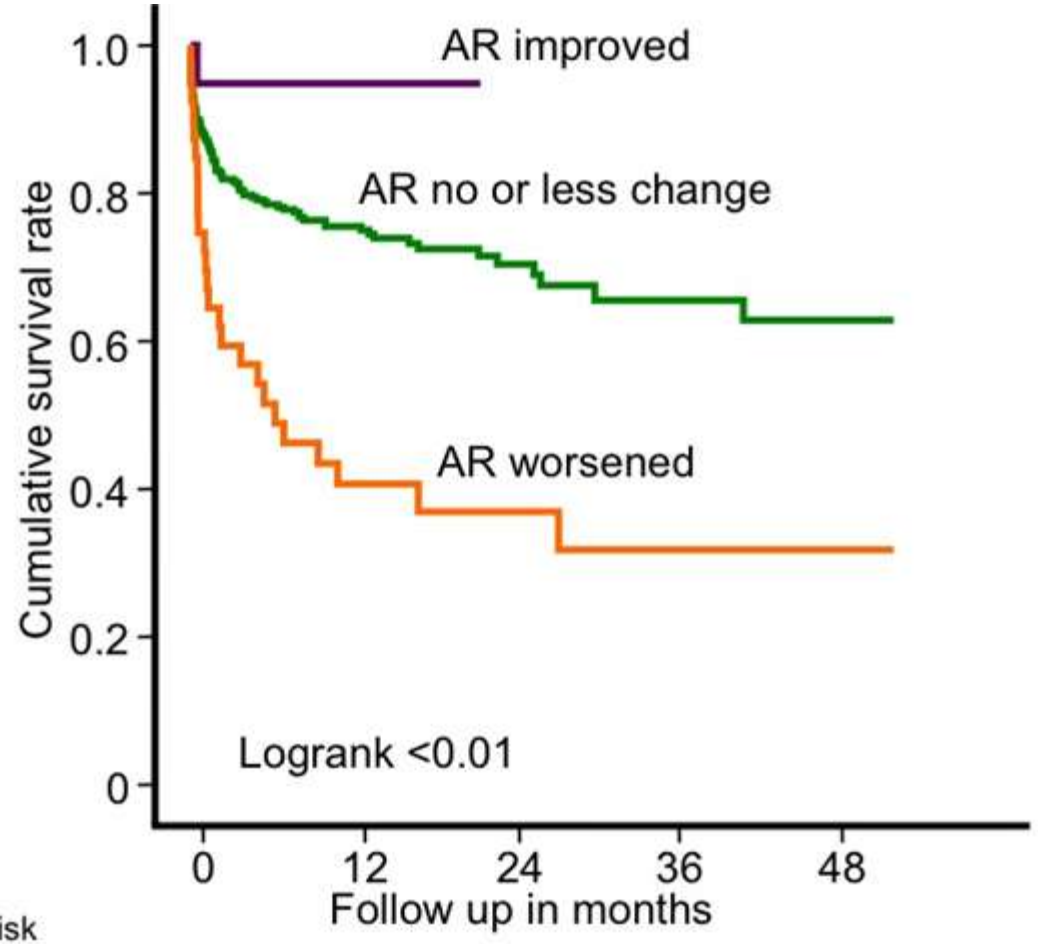
Overestimation = Risk of annulus rupture

Valve dysfunction ?

Underestimation = Risk of embolization

Risk of Aotic regurgitation

# Increasing AR is the worst scenario

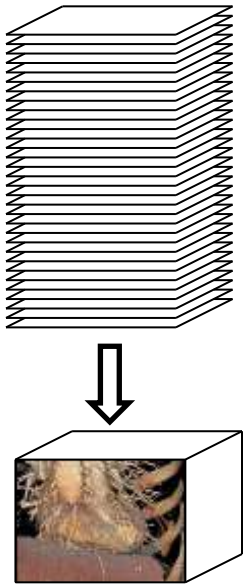


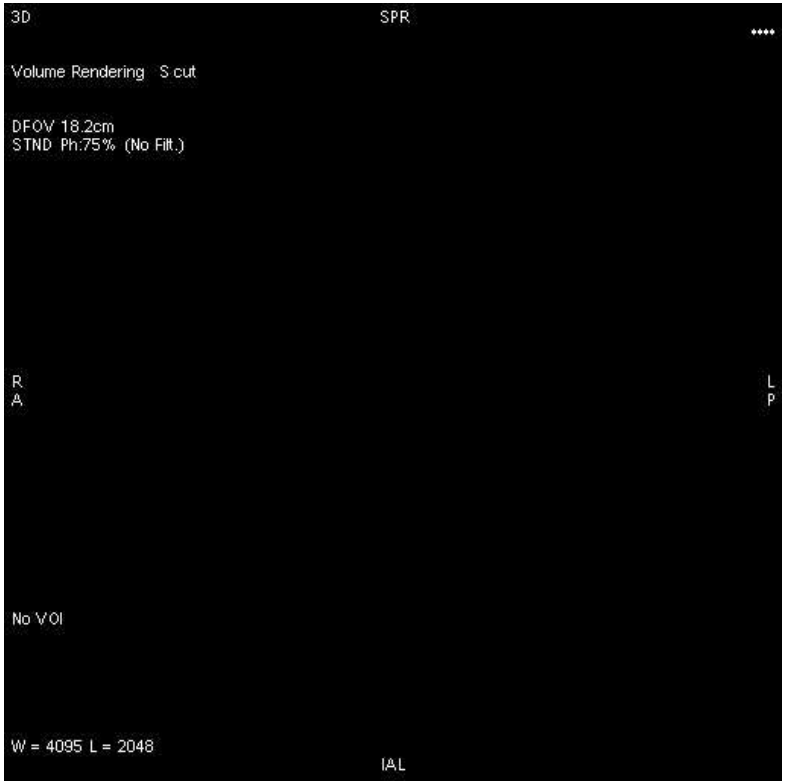

| Number at risk | | | | | |
|---|---|---|---|---|---|
| AR improved | 20 | 10 | | | |
| AR no or less change | 339 | 157 | 71 | 46 | 9 |
| AR worsened | 41 | 16 | 7 | 5 | 2 |



Hayashida et al. J Am Coll Cardiol Interv 2012

# CT scan

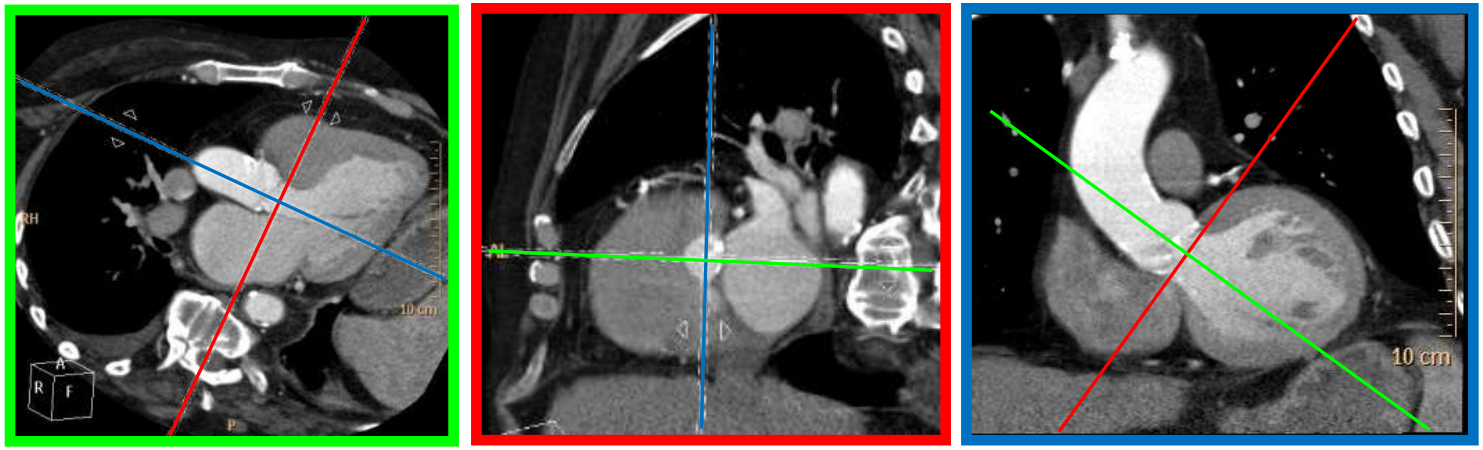



High Resolution (0.5 mm) in the 3 axes (X, Y, Z)

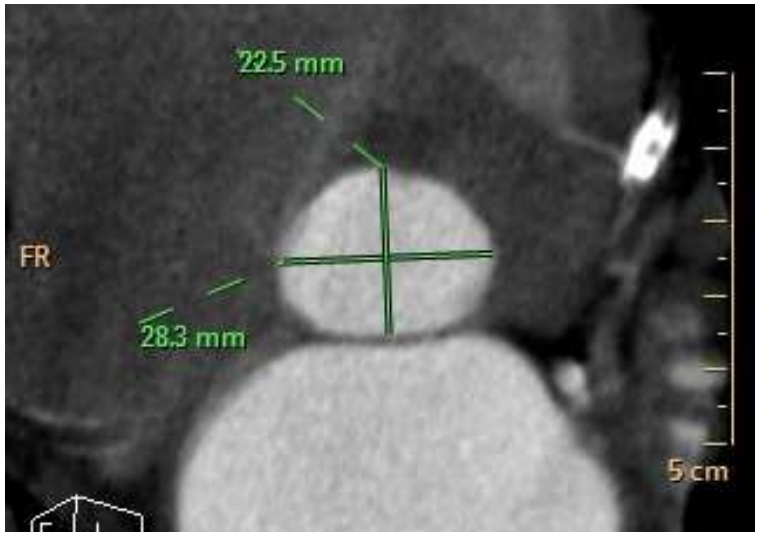
True 3D imaging

Optimal for calcified structures and prosthetic material

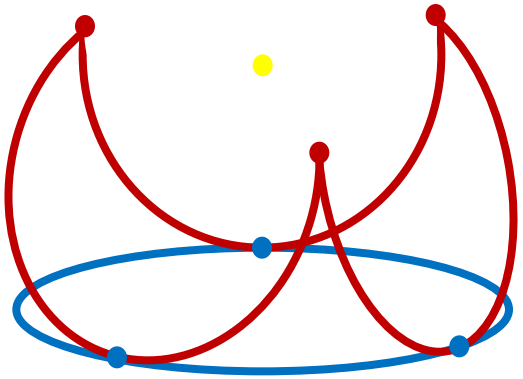
# CT scan is 3D & isotropic

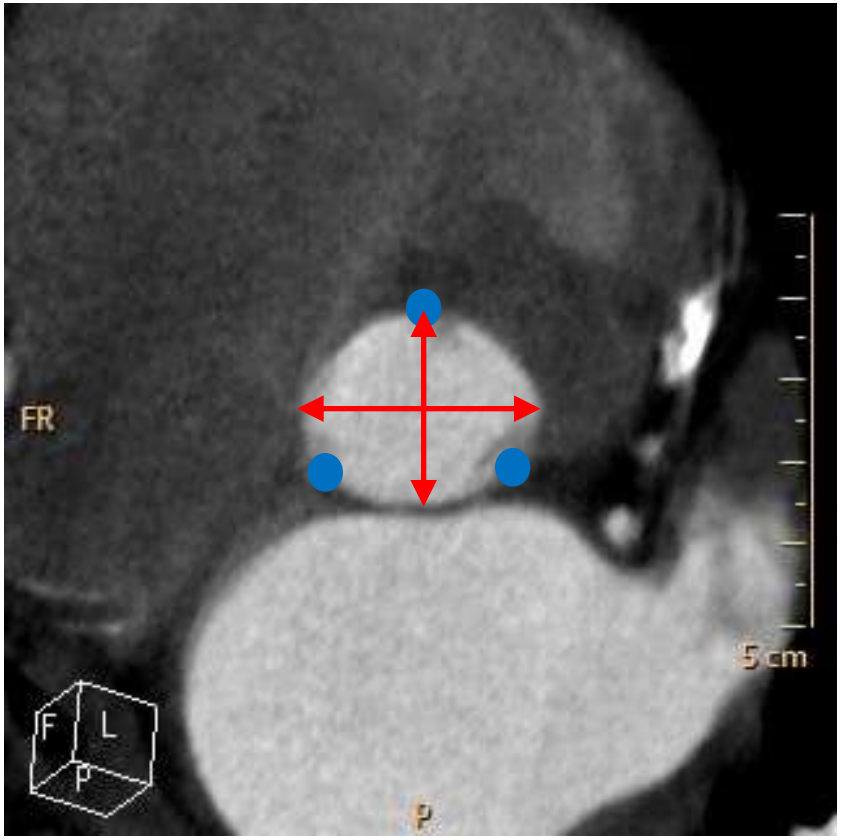



- Resolution = 0.5 mm in all directions
- May help to determine the optimal view




# Annulus is not a circular crown






- ✓ Variable orientation (≤30° )
- ✓ Small diameter is often antero-posterior (= Echo)
- ✓ Large diameter grossly lateral
- ✓ Variability between the 2 diameters (4-5mm, from 1 to 8mm)

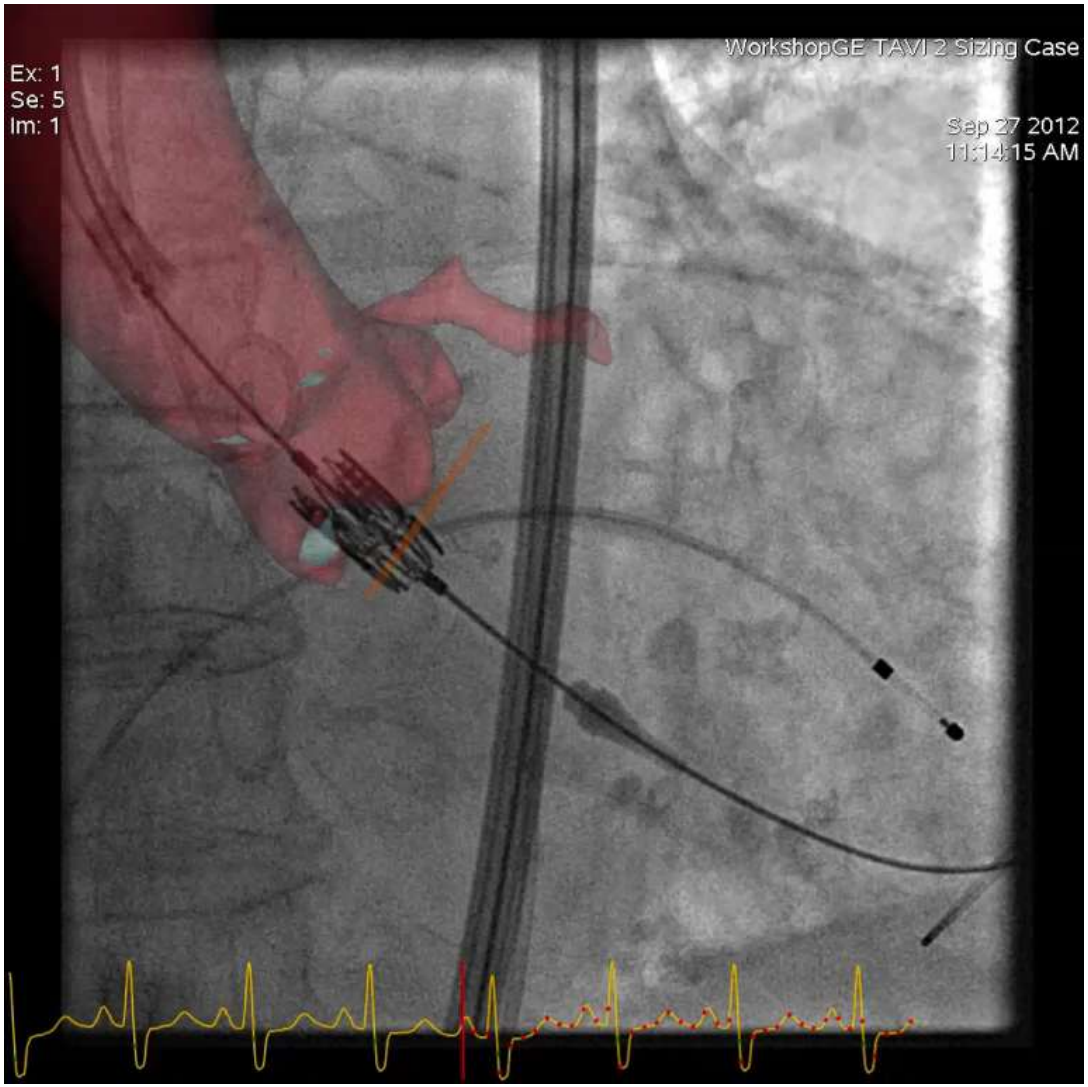
# MSCT versus TEE guidance

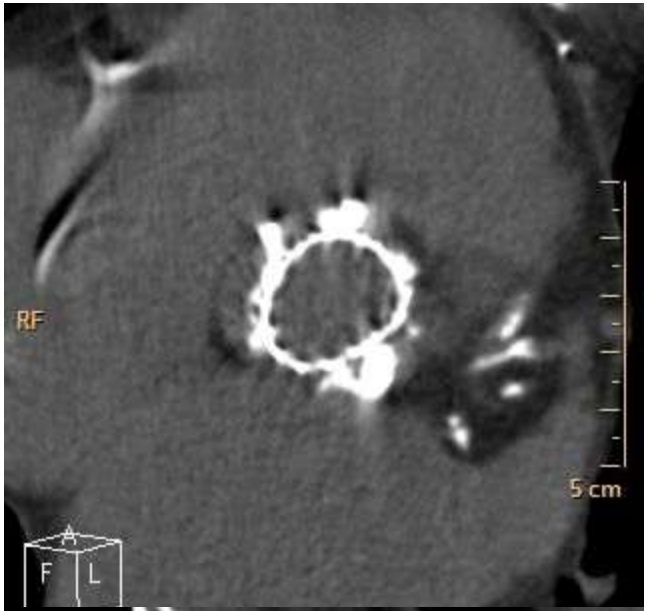
| | CT-guided | TEE-guided | P |
|---|---|---|---|
| Patient number | 175 | 175 | |
| Mean pressure gradient, mmHg | 10.1 ± 4.0 | 11.3 ± 4.8 | 0.02 |
| LVEF, % | 55.0 ± 11.8 | 53.8 ± 13.1 | 0.43 |
| **Aortic regurgitation ≥2** | **27 (15.4%)** | **42 (24.0%)** | **0.04** |
| Cardiac tamponade | 5 (2.9%) | 4 (2.3%) | 0.74 |
| **Annulus rupture** | **1 (0.6%)** | **3 (1.7%)** | **0.31** |
| Valve migration | 1 (0.6%) | 4 (2.3%) | 0.19 |

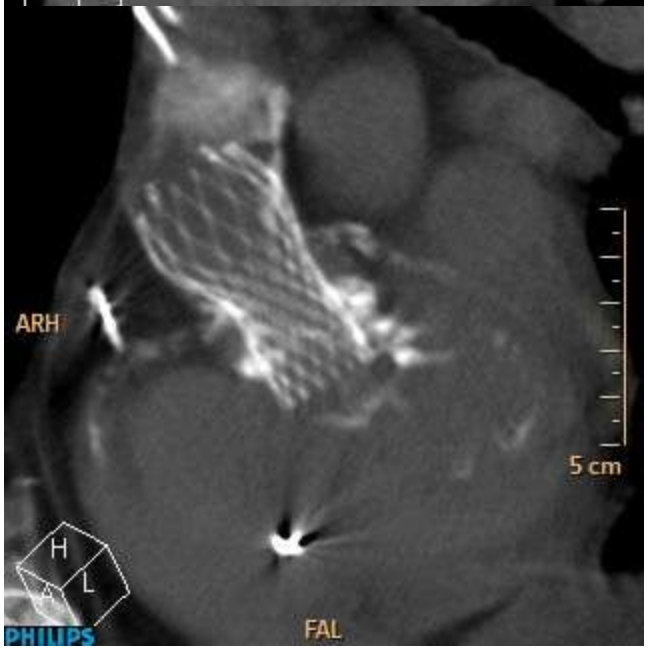
# During TAVI

# View selection

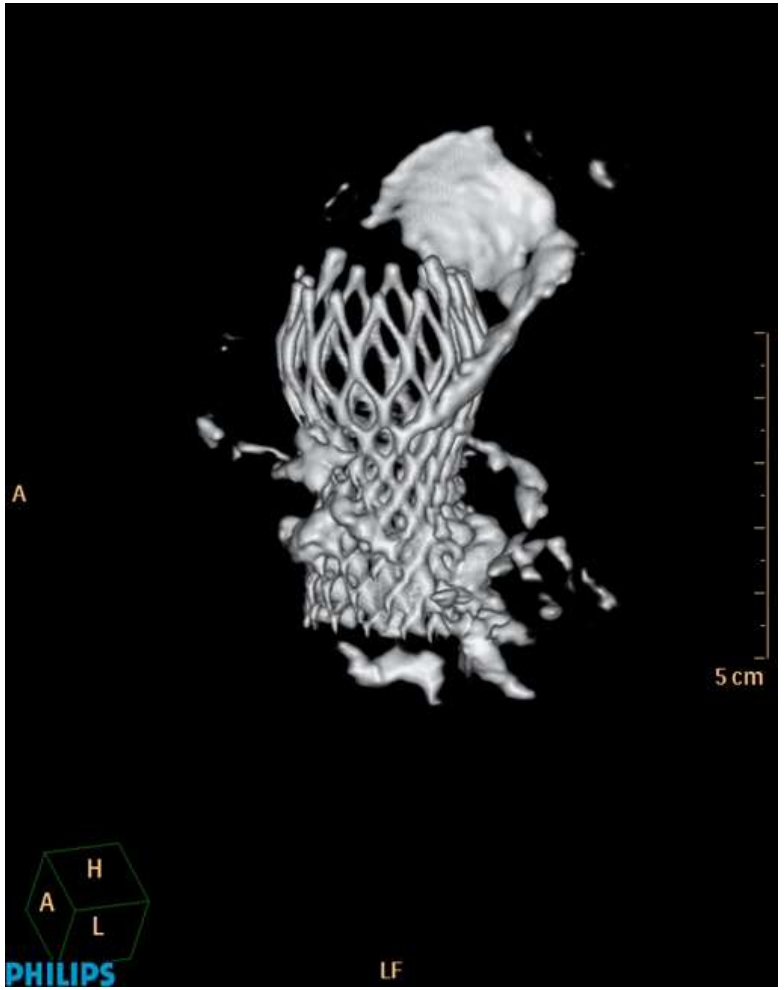

# Optimal Positioning





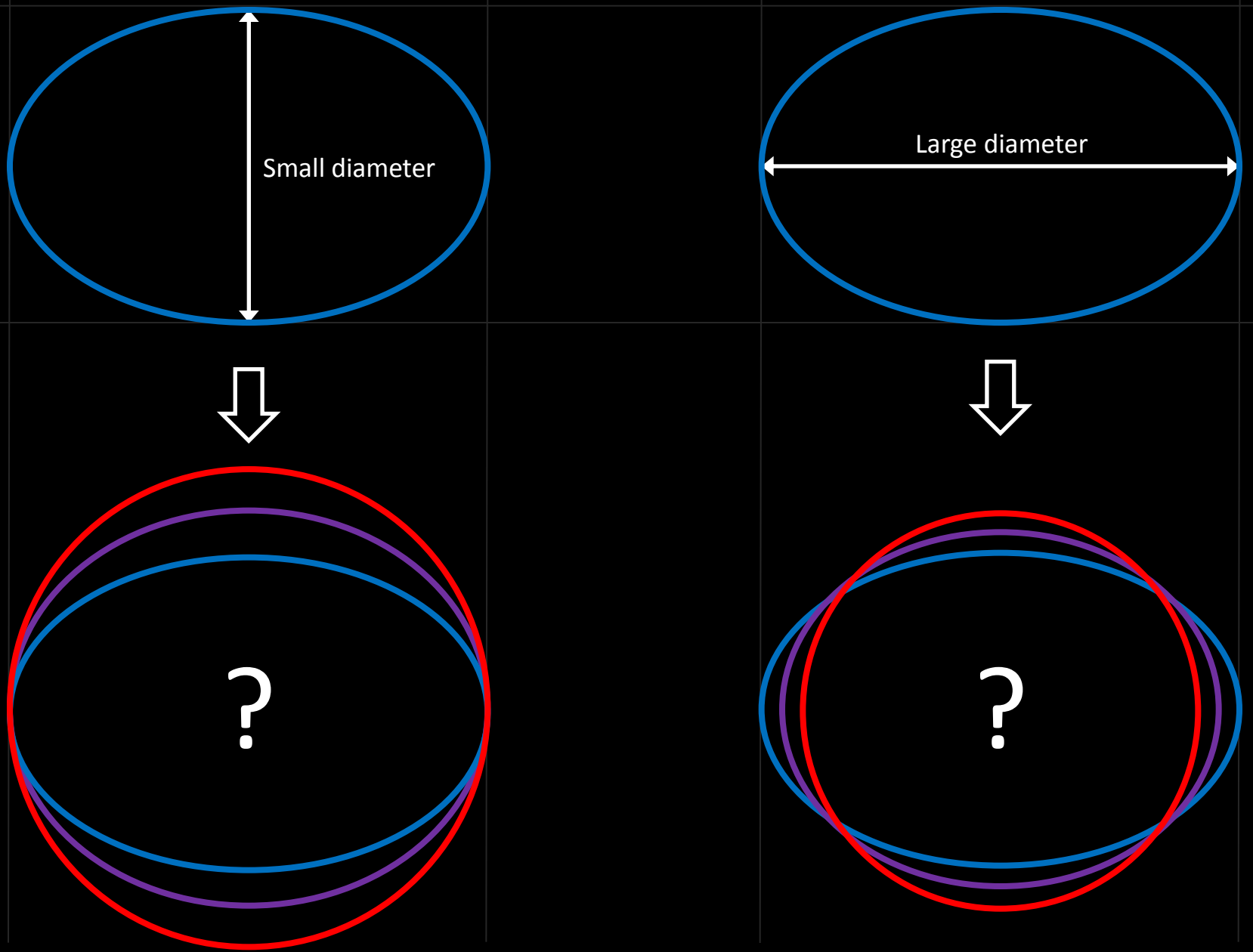

# After TAVI



# Methods

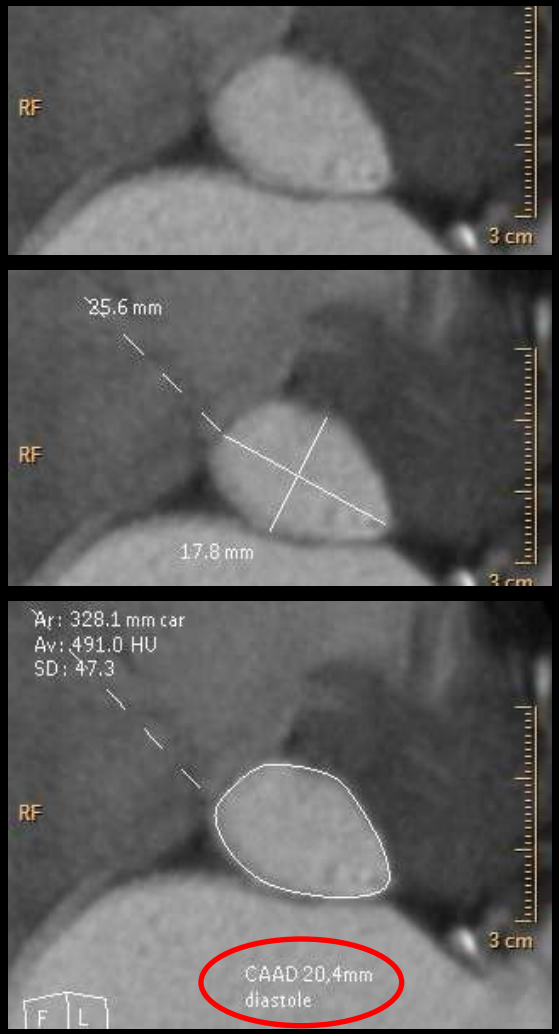
- 68 patients pre & post TAVI MSCT
- Larger annulus diameter for Corevalve
- Similar eccentricity of annulus and calcium volume
- Similar depth of implantation (4.3 +- 4 mm for Corevalve and 4.3 +- 2.5 mm for Edwards)

# Annulus Reshaping after Valve Deployment



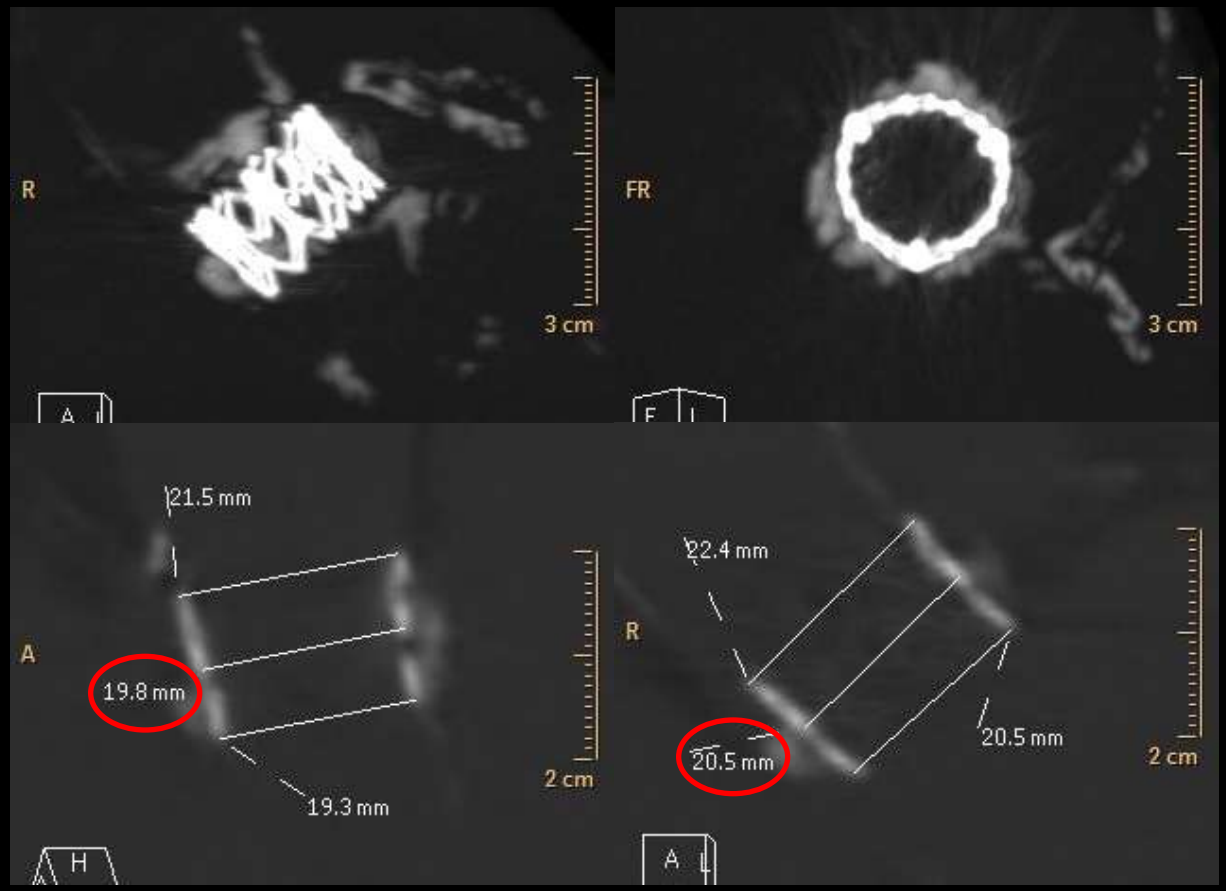
# Balloon-expandable valve

## BEFORE

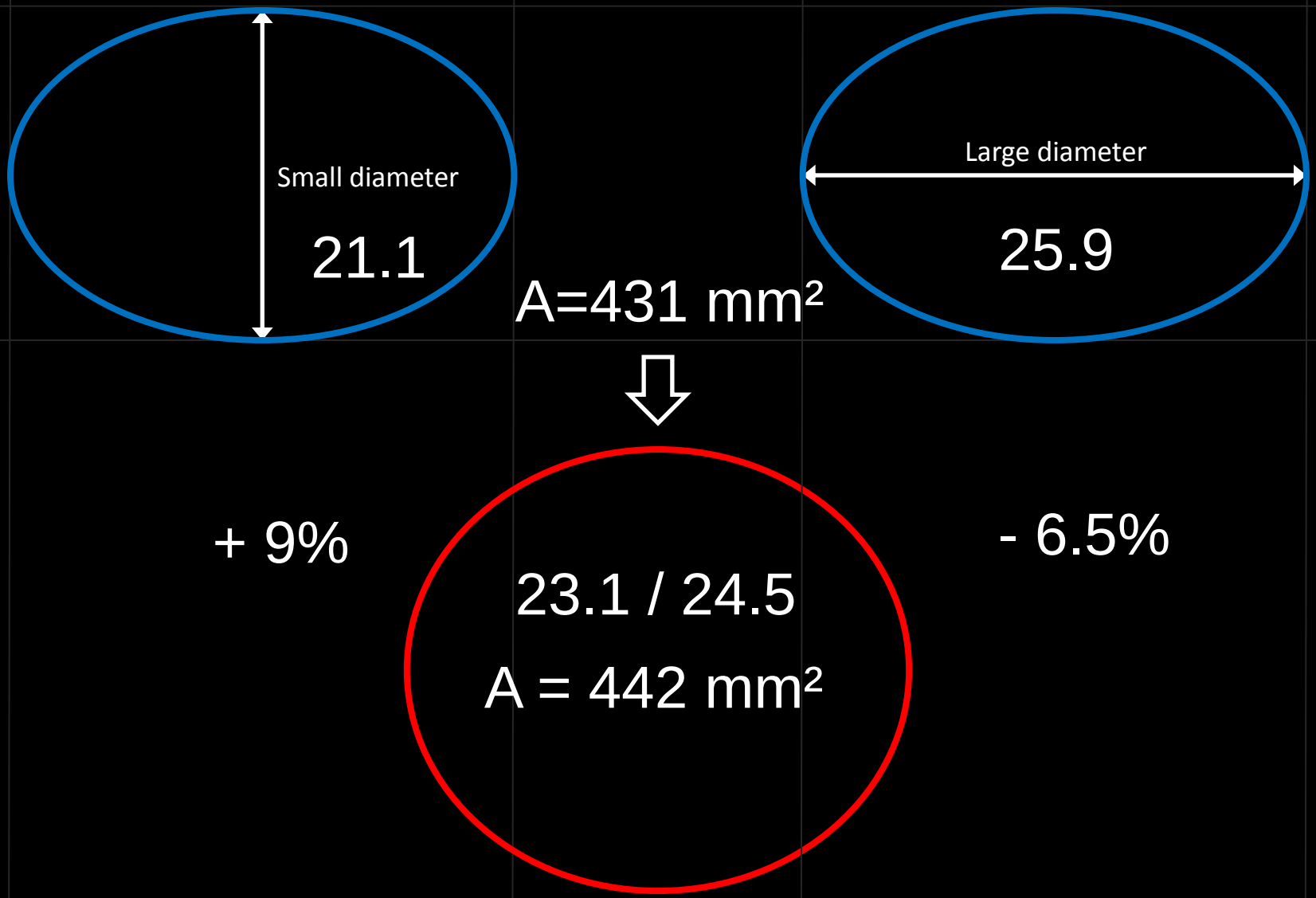



## AFTER

Sapien Valve 23mm



# Annulus Reshaping after Valve Deployment: Edwards



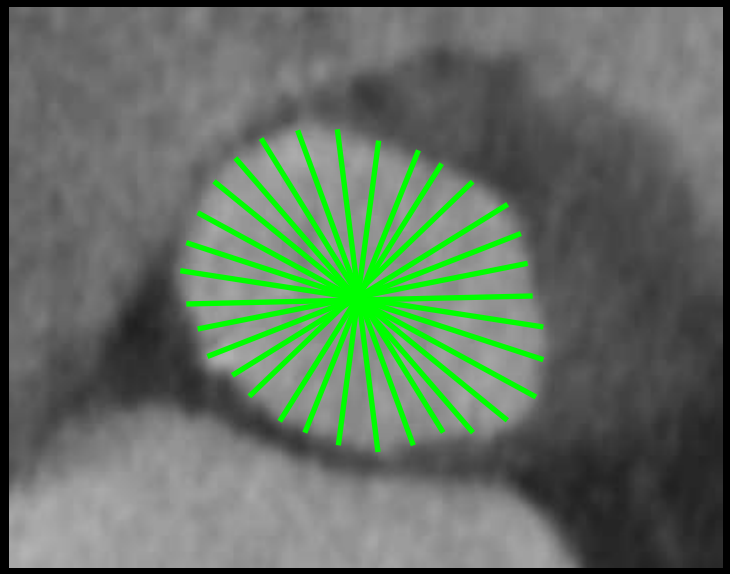

Eccentricity (22%) only is predictive of AR > 1

# What is CAAD ?

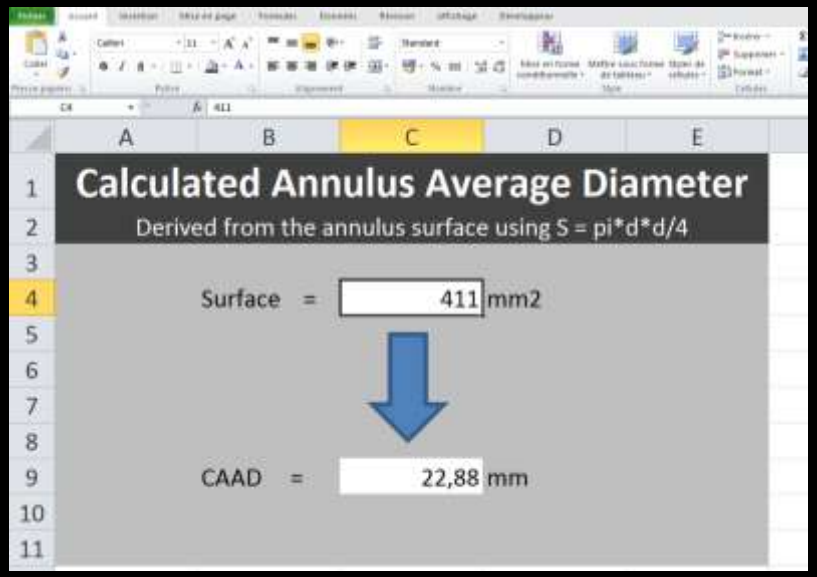
**CAAD** = **C**alculated **A**verage **A**nnulus **D**iameter

Is derived from the annulus surface via the formula :

$$CAAD = 2 * \sqrt{\frac{annulus\ surface}{\pi}}$$



= Geometric mean of diameters
= Represents the mean of all the diameters of the annulus, whatever its shape




Can be calculated by your local CT reporting database or by a very simple spreadsheet tool

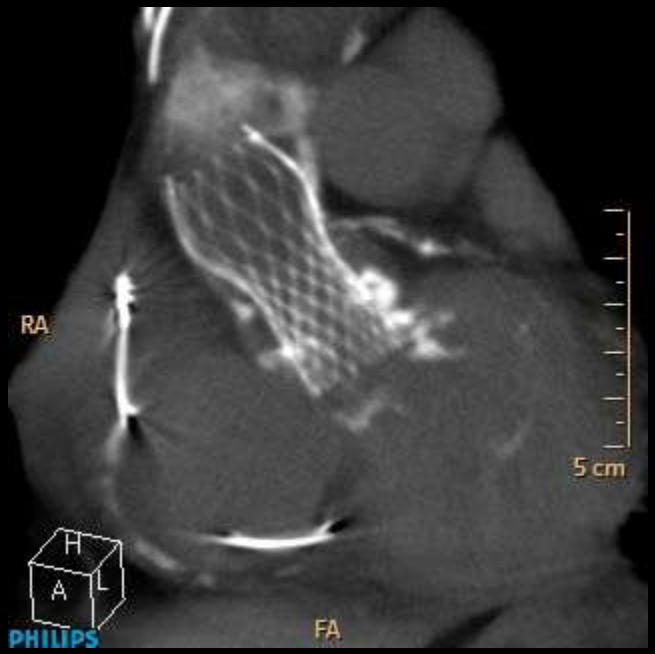
# Sizing strategy **Edwards Sapien**

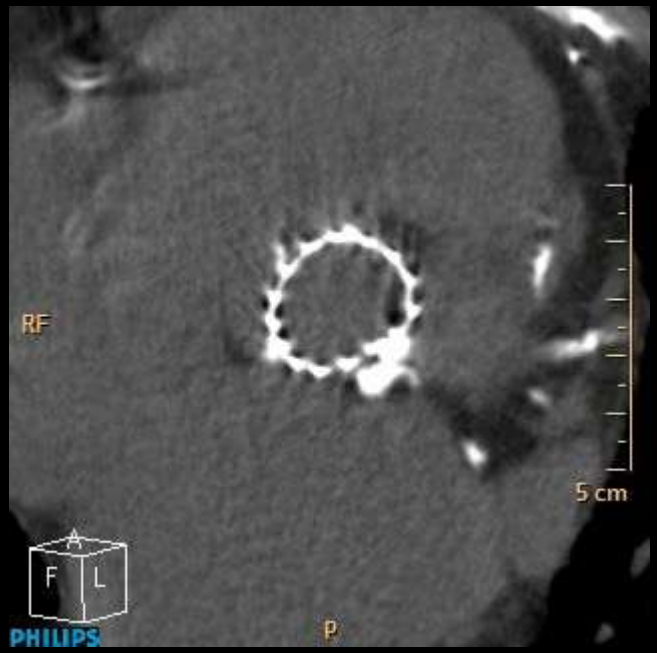
**Cardiac CT**

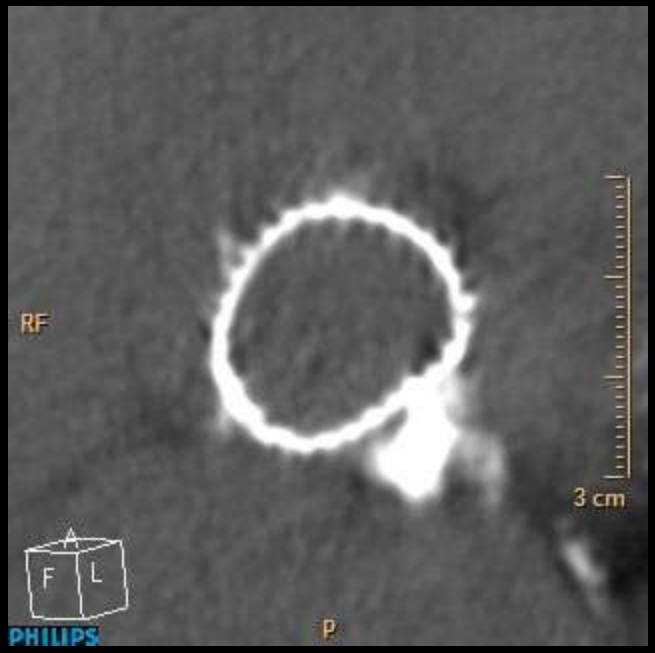
| CAAD ≤ 22 mm | CAAD ≤ 25mm | CAAD ≤ 27mm |
|---|---|---|
| **Edwards 23mm valve** | **Edwards 26mm valve** | **Edwards 29mm valve** |

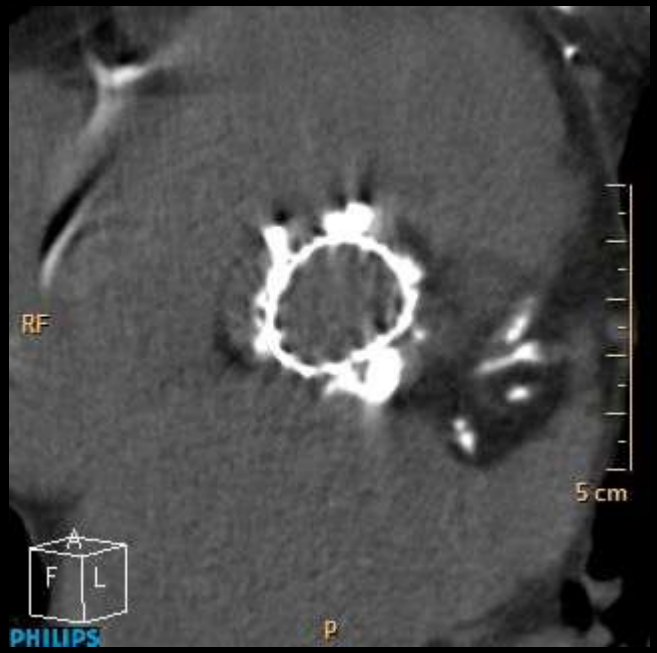
CAAD = geometric mean diameter
LD = large diameter

Massy

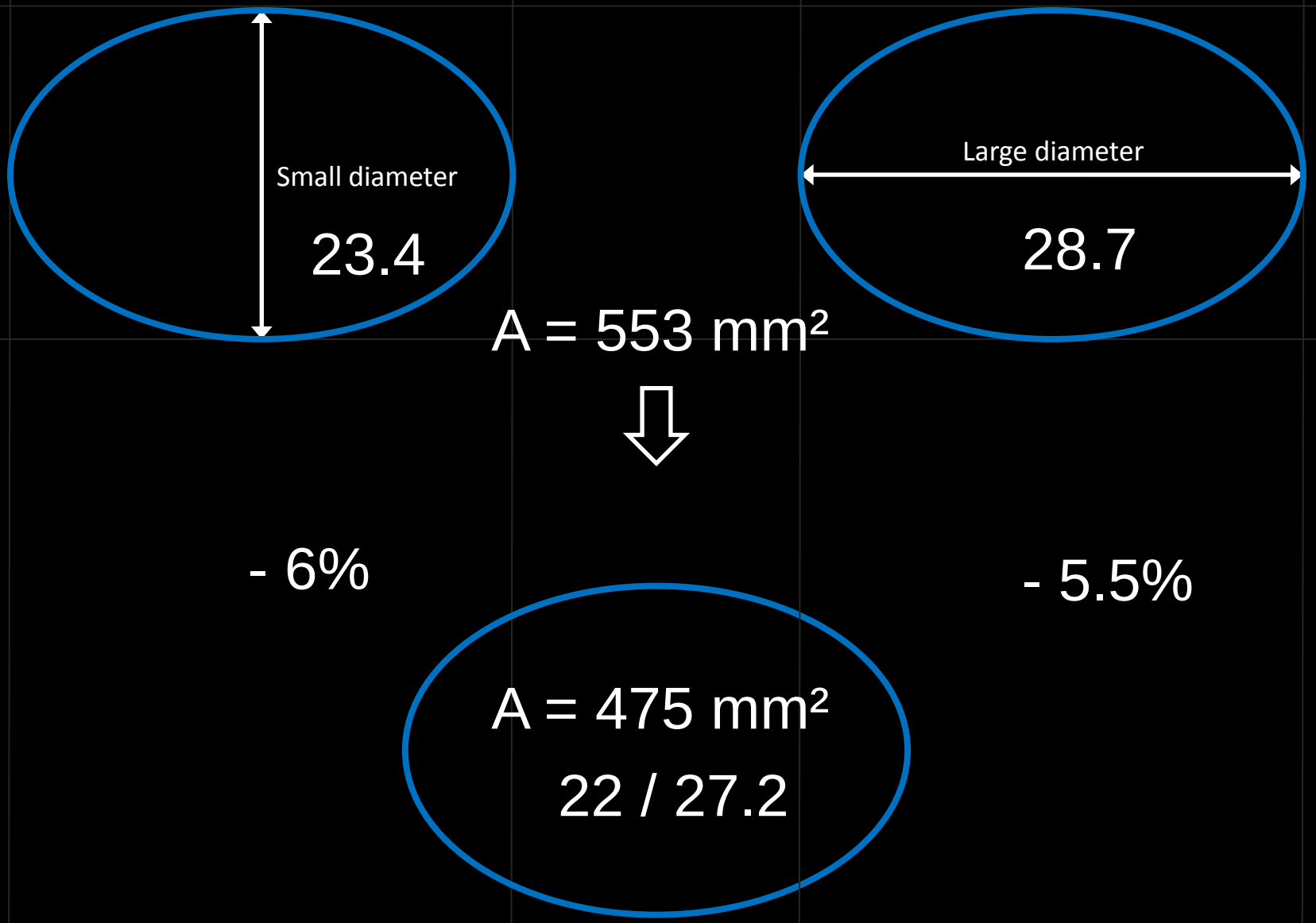

RA
5 cm
H
A
L
PHILIPS
FA


RF
5 cm
A
F
L
PHILIPS
P


RF
3 cm
A
F
L
PHILIPS
P

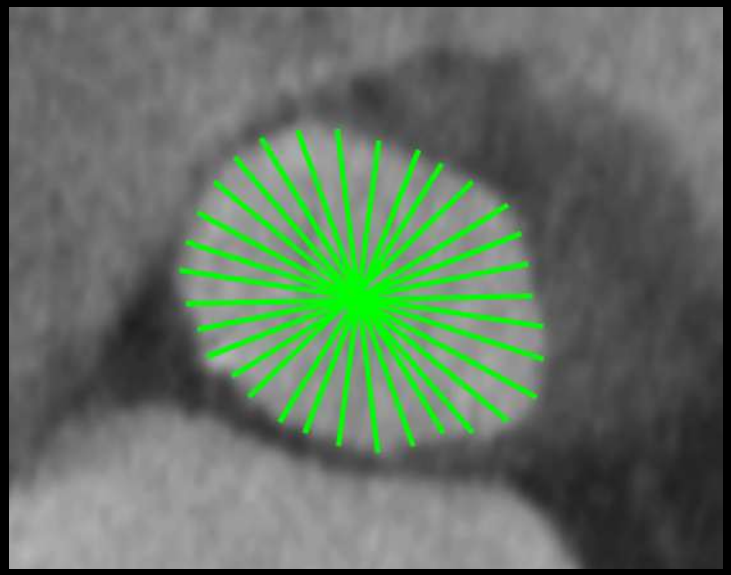

RF
5 cm
A
F
L
PHILIPS
P

# Annulus Reshaping (?) after Valve Deployment: Corevalve



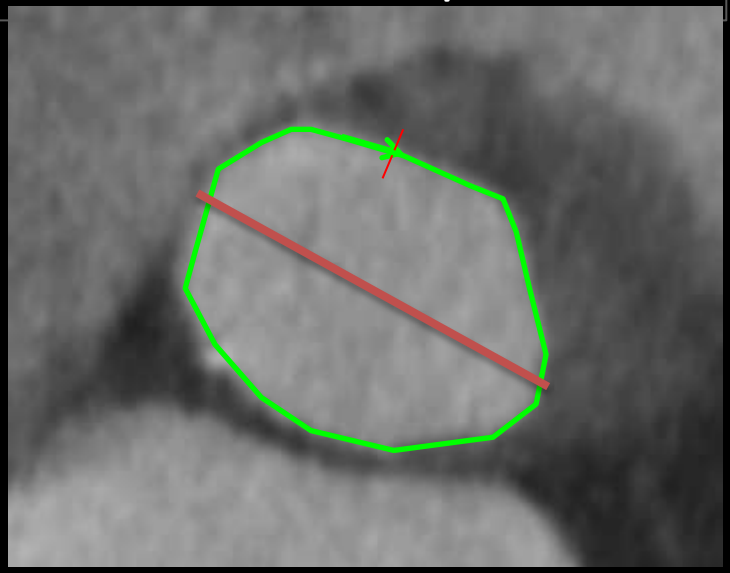

Eccentricity (86%) is not predictive of AR >1

# Impact on pre-TAVI sizing on MSCT



Mean annulus diameter derived from the annulus perimeter via the simpler formula :

$$D = \text{Perimeter} / \pi$$



- Assumes that fibers length in the annulus remain stable after TAVI

# Sizing strategy **Medtronic CoreValve**

**Cardiac CT**

Max < 26mm

Max < 29mm

Max < 31mm

**CoreValve 26mm valve**

**CoreValve 29mm valve**

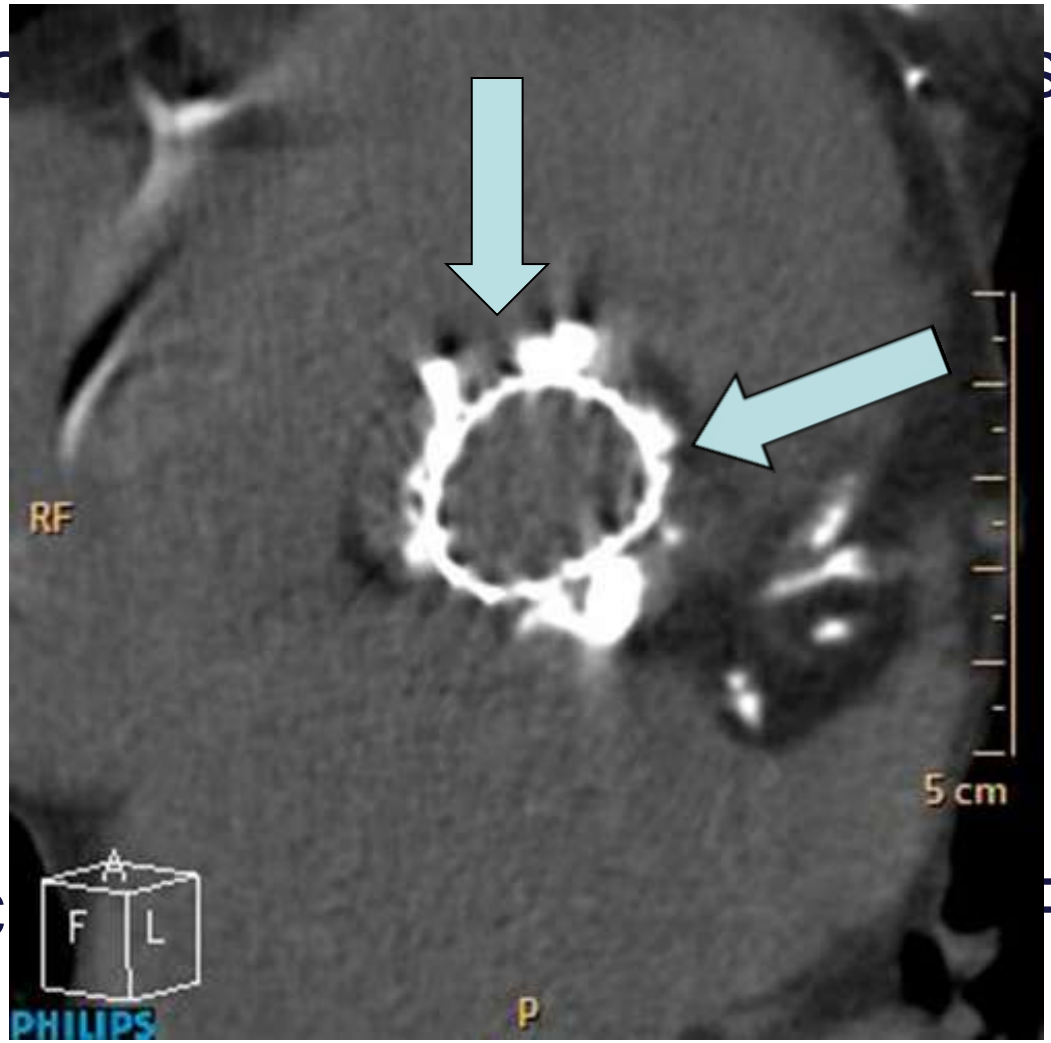
**CoreValve 31mm valve**

CAAD = geometric mean diameter
LD = large diameter

Massy

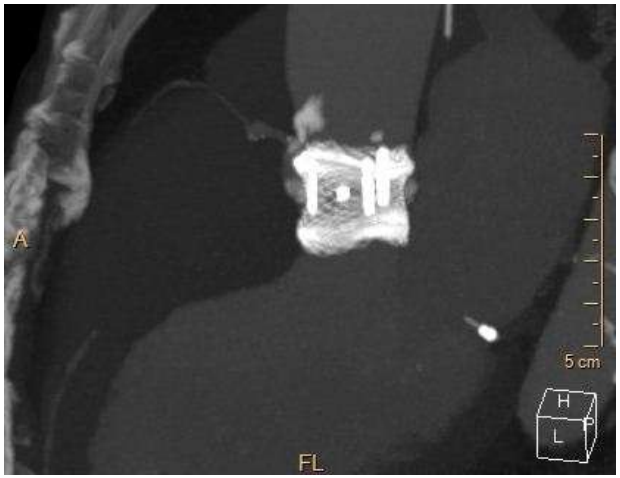
# Corevalve & calcifications

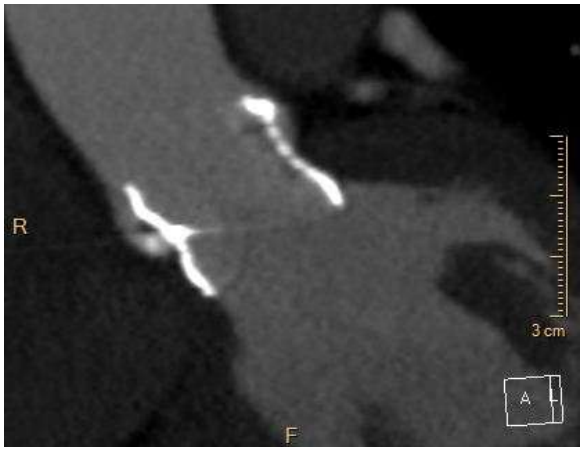
- Trend for mo sus 18%)

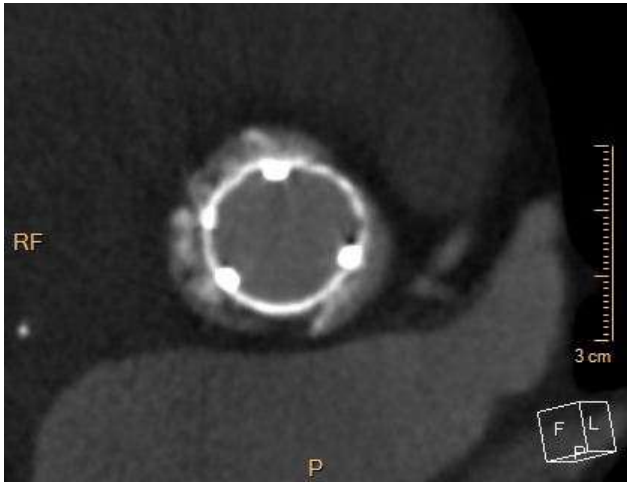


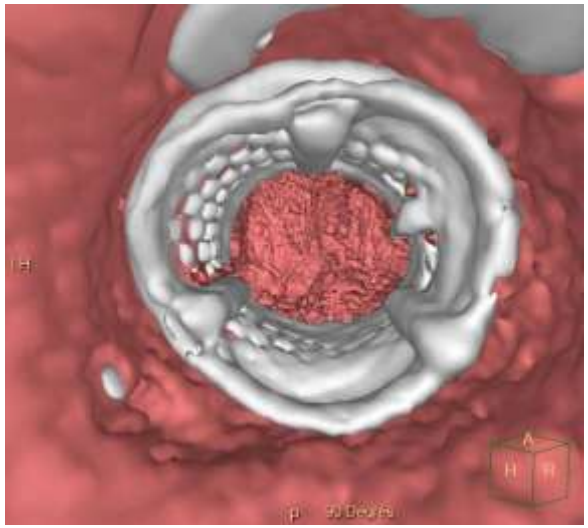

- Volume calc R

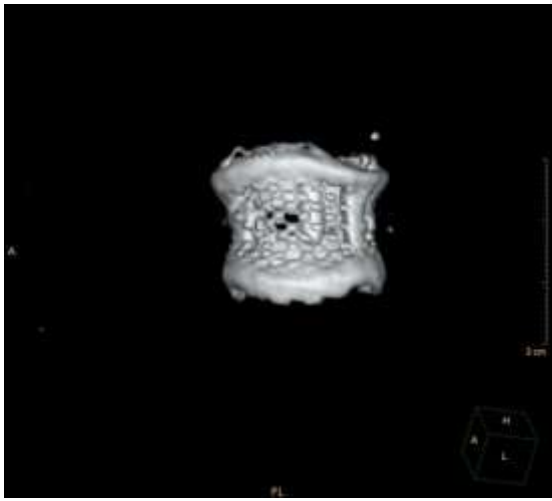
# New valve Evaluation: Lotus



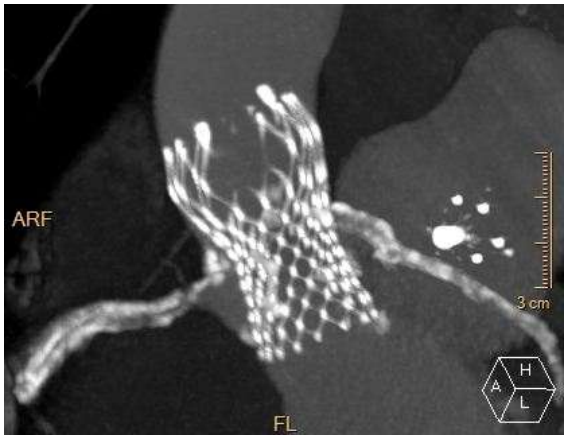



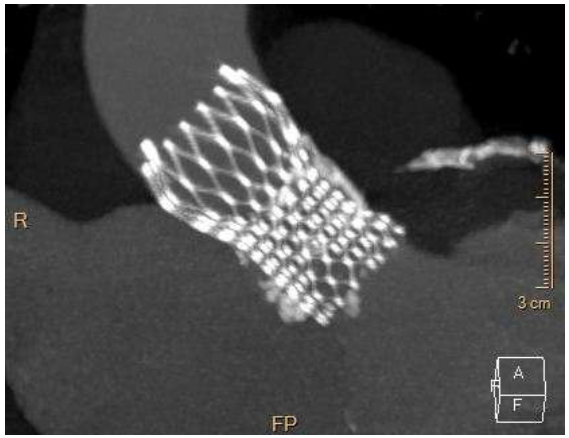





# MSCT @ late F-up

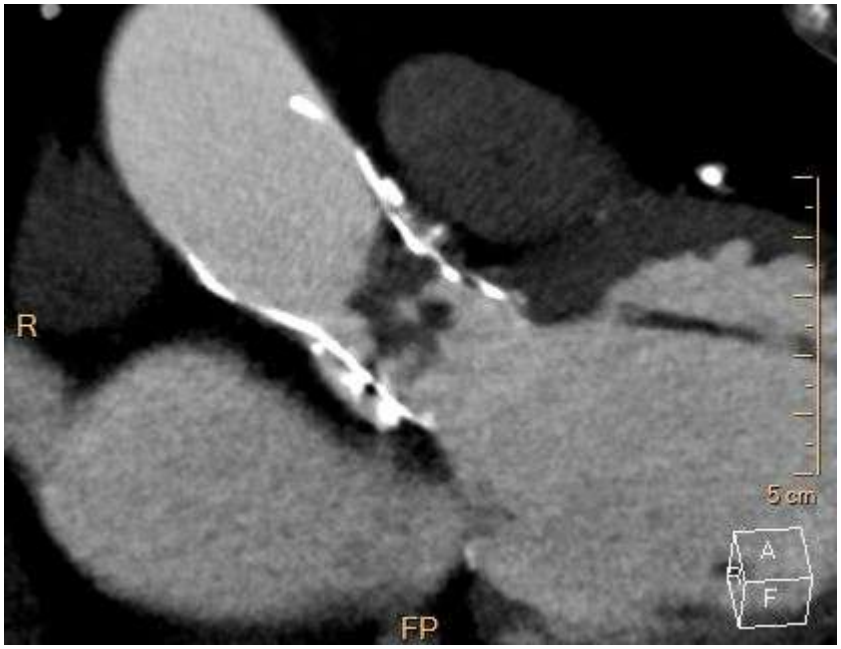
- 18 months after Corevalve implantation
- Minor stroke (x 2)
- Mean gradient 26 mmHg (7 post)

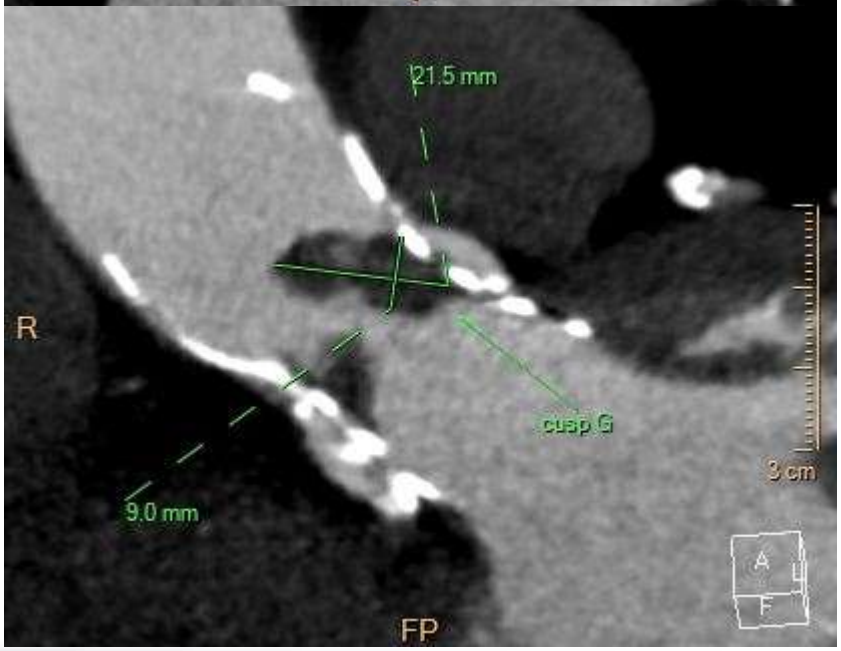


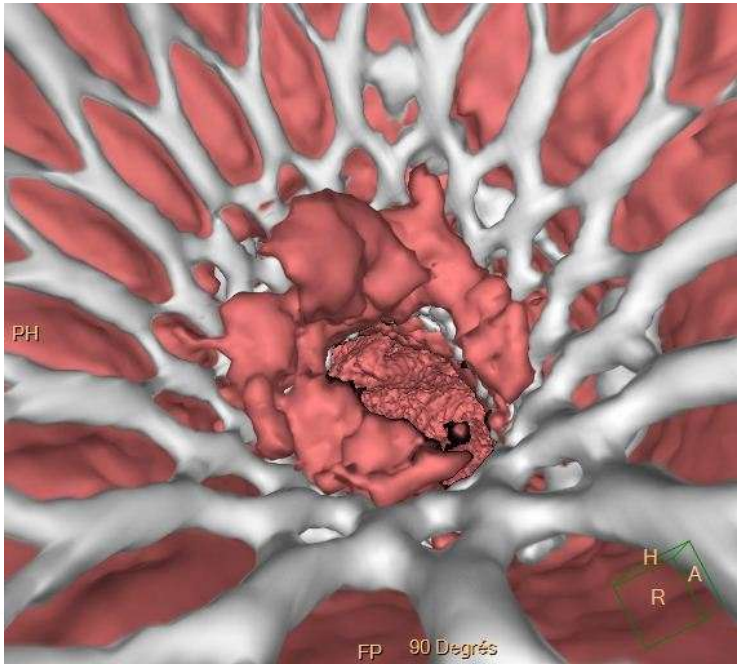



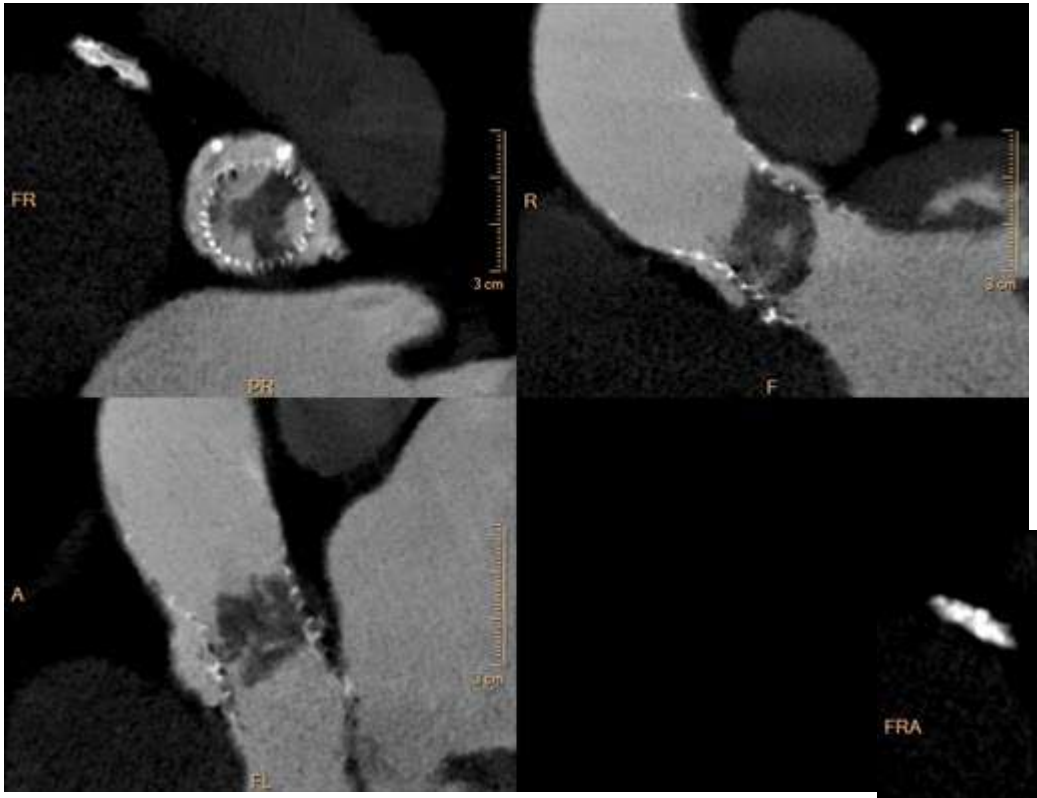


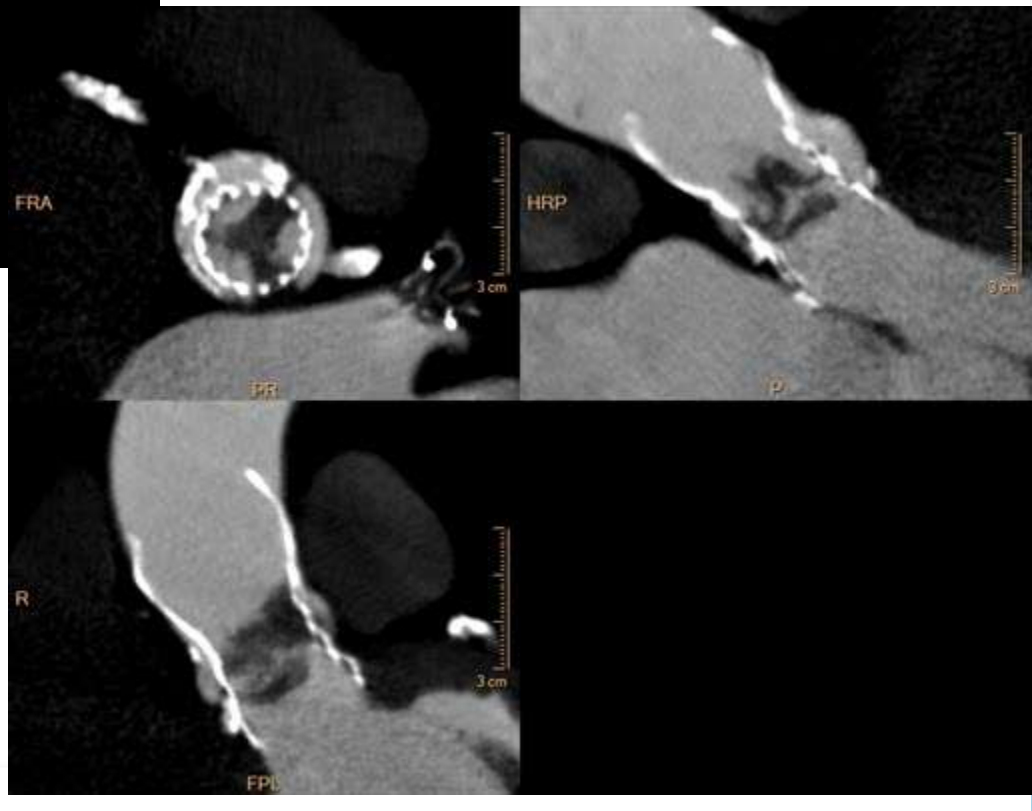
FR
5 cm
F
L
P
P


R
5 cm
A
F
FP


21.5 mm
R
cusp G
3 cm
9.0 mm
A
F
FP


PH
H
A
R
FP
90 Degrés


FR
3 cm
PR
R
3 cm
F
A
3 cm
FL


FRA
3 cm
PR
HRP
3 cm
P
R
3 cm
FPL

# Conclusions

- ✓ Pre-TAVI MSCT is crucial for screening
- ✓ Sapien & Corevalve have a totally different behavior
  - ✓ Strong impact of Sapien on annulus shape
    - ✓ Risk of rupture
  - ✓ Conformability of Corevalve
    - ✓ Risk of malapposition & AR in highly calcified commissure
- ✓ Post-TAVI MSCT brings important information for valve selection & sizing
  - ✓ New valve
- ✓ Important tool to analyse the mechanism of late rise of gradient
  - ✓ Degenerative versus thrombotic