Assessment of Aortic Valve Disease Prior to Transcatheter Therapy TEE, 3-D TEE, MR/CT and Beyond

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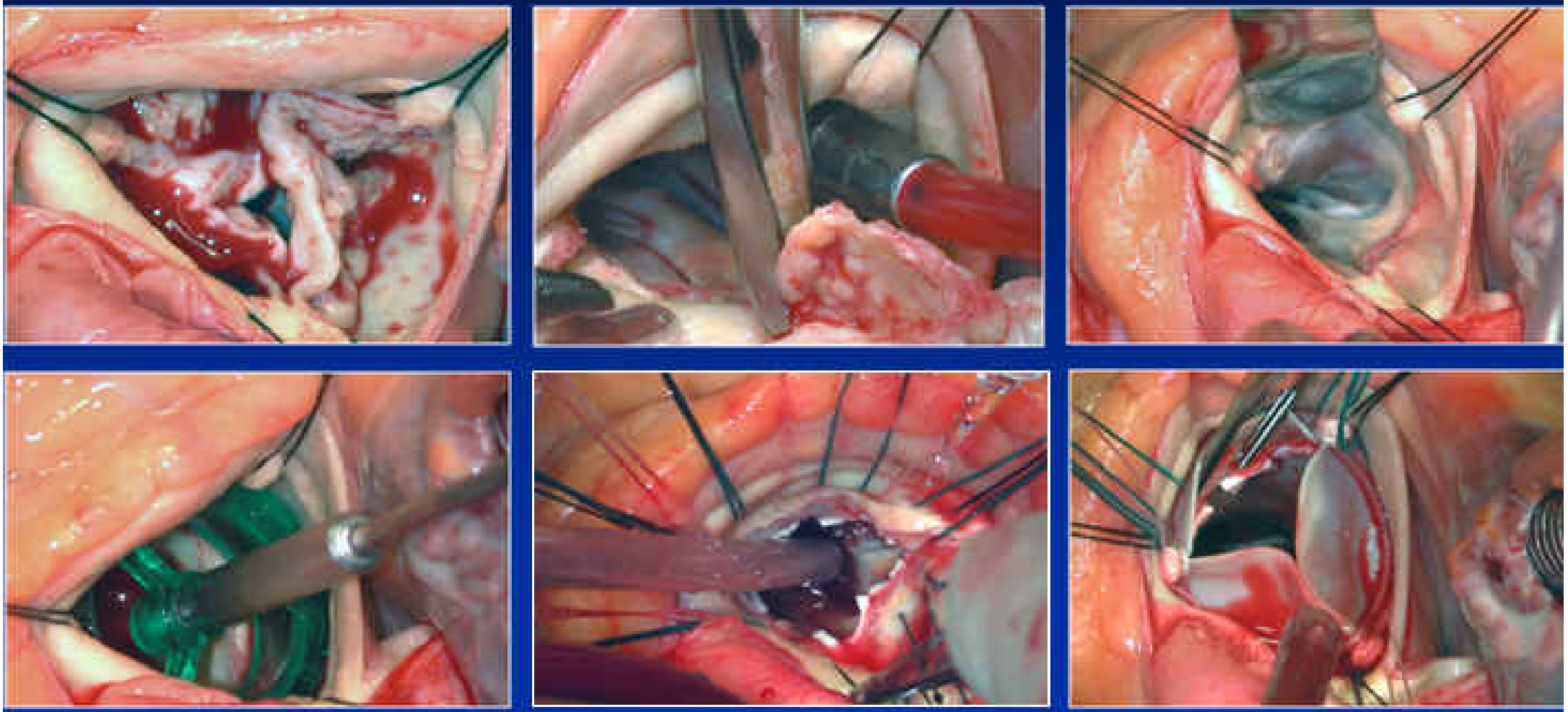
Cleveland Clinic

Surgical Aortic Valve Replacement



Courtesy of Dr. Gosta Pettersson

Evolution of Valve Interventions

Conventional Surgery → "Minimally Invasive" Surgery → Robotic Surgery → Percutaneous "Procedures"

- Specific Devices
- Small Exposure
- Distant Device Manipulation

- Heart not beating
- Direct visualization of anatomy & devices
- Transcutaneous access

- Beating heart
- Indirect (US or X-ray) visualization of anatomy & devices
- Intravascular access

Role of Imaging

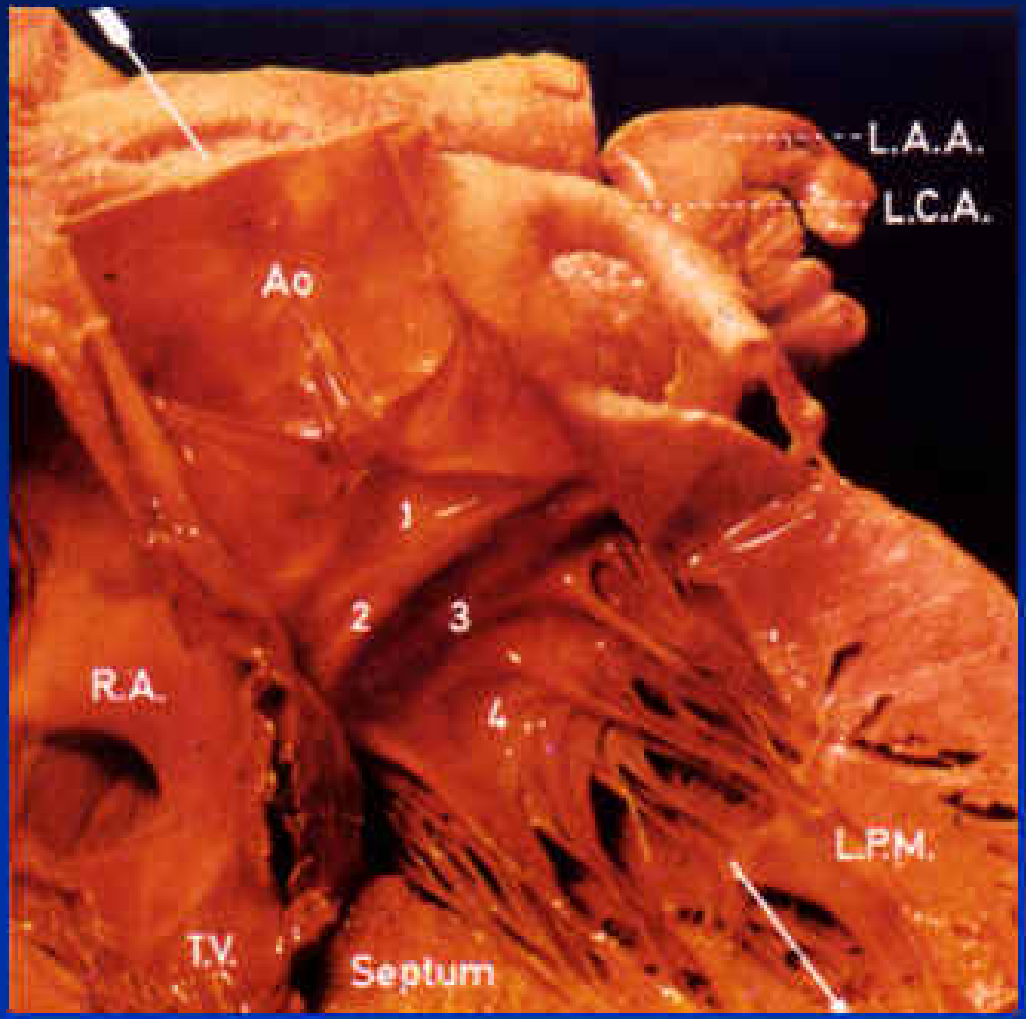
Pre Procedural Planning: Visualizing anatomy

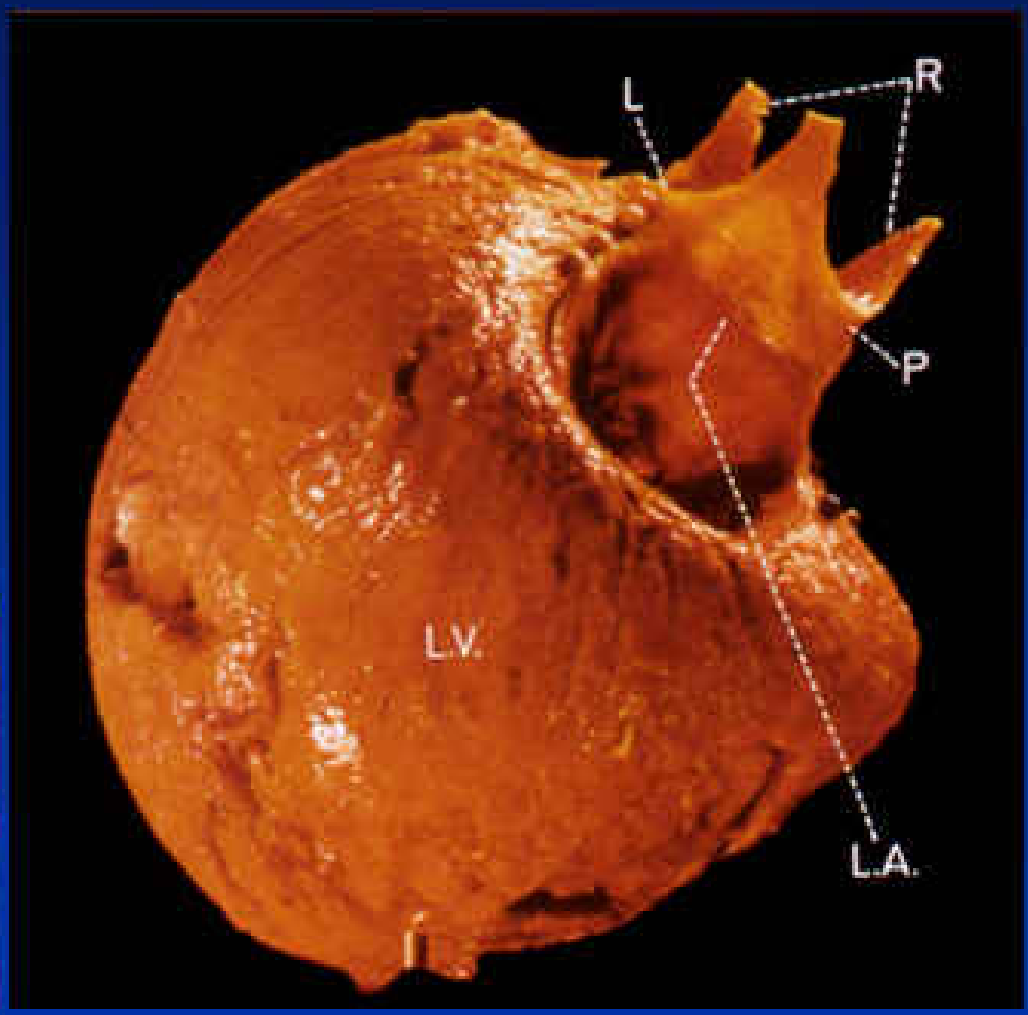
- Aortic valve
- Ascending aorta and arch
- Pelvic vasculature

Procedural guidance

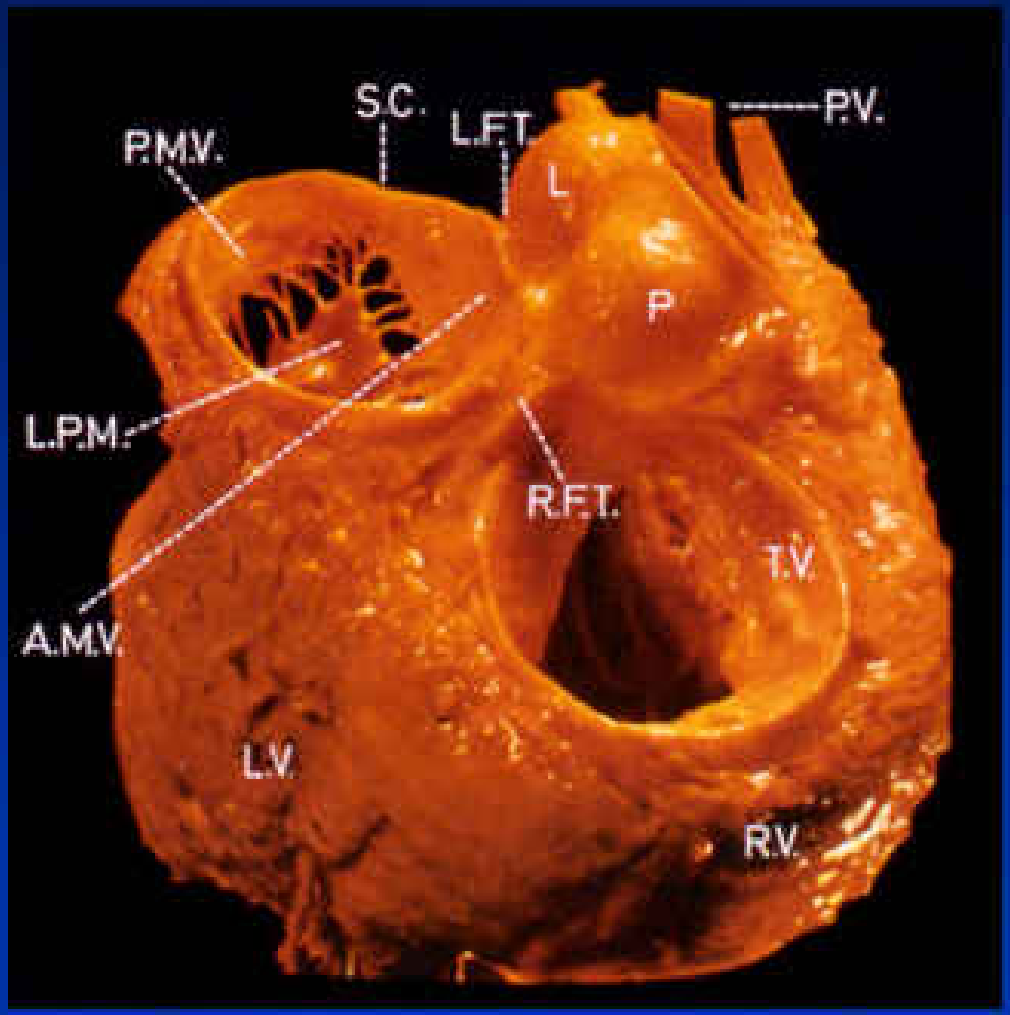
- Device visualization and precise deployment

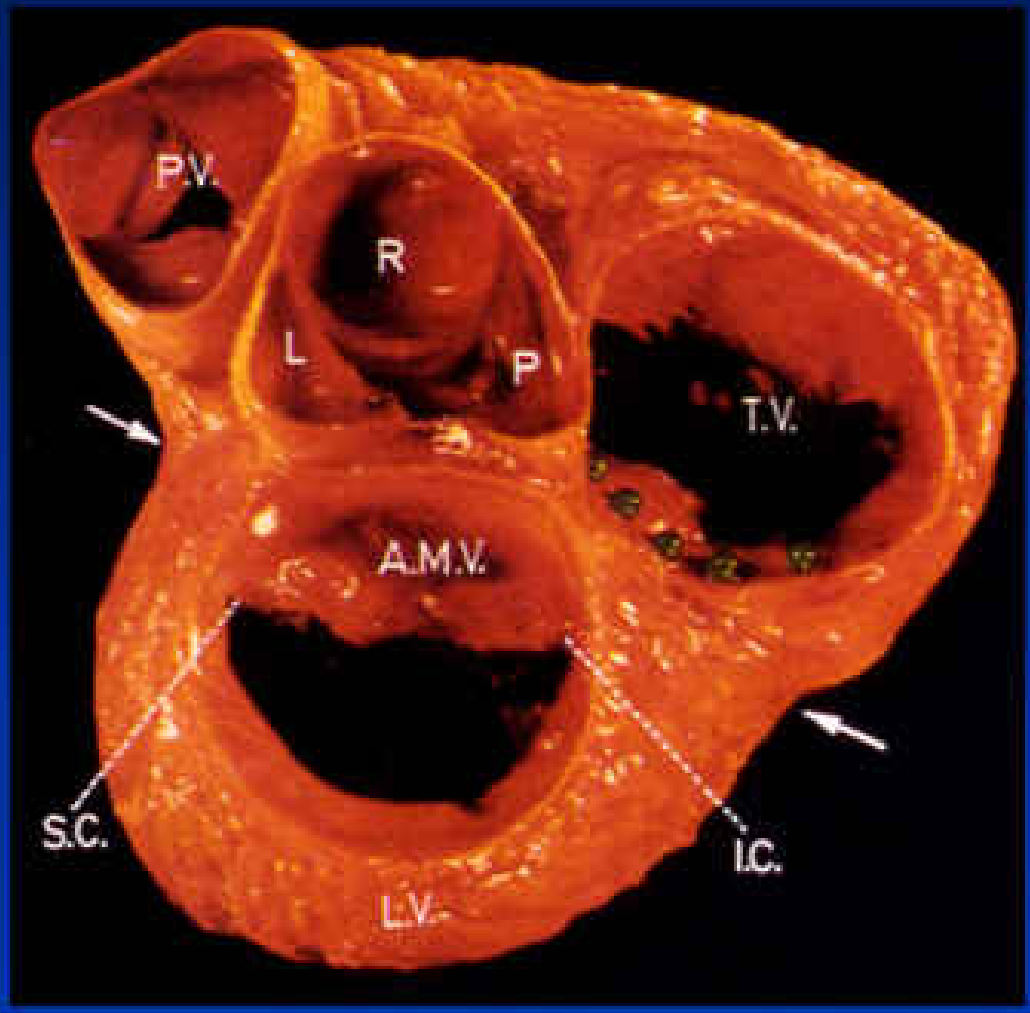
Aortic Valve Anatomy



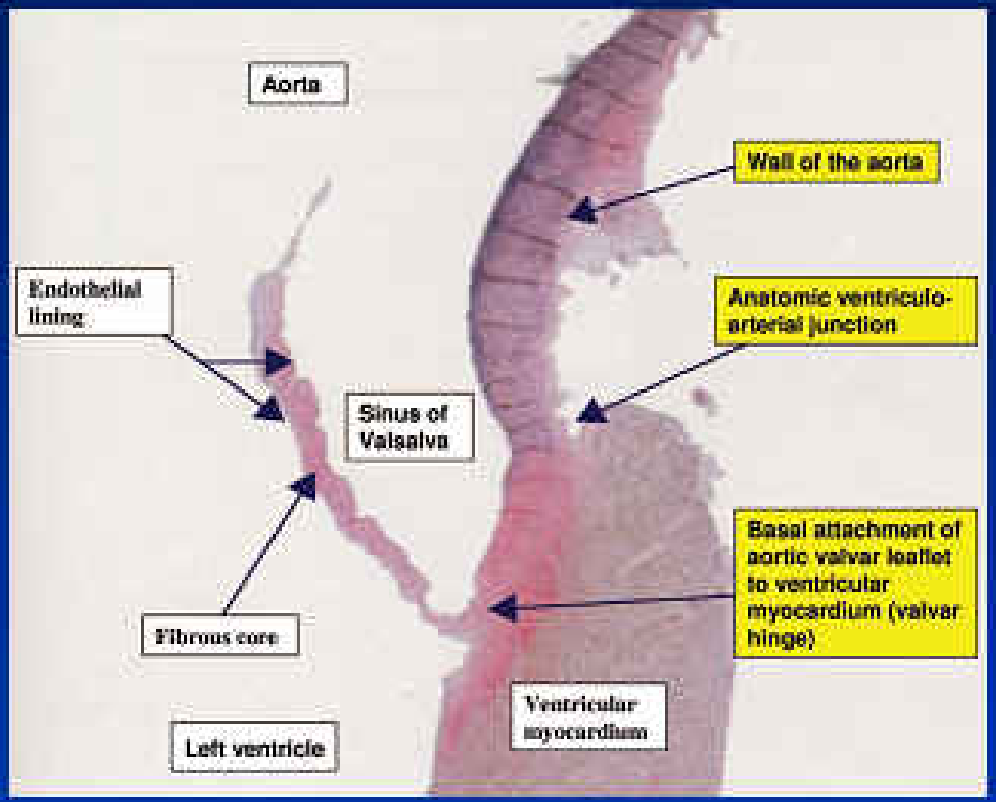


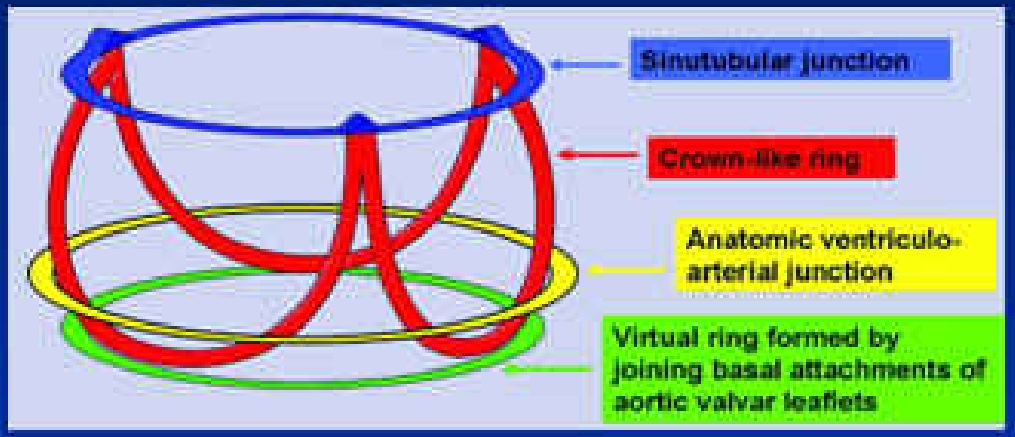
Anatomy of Aortic Root





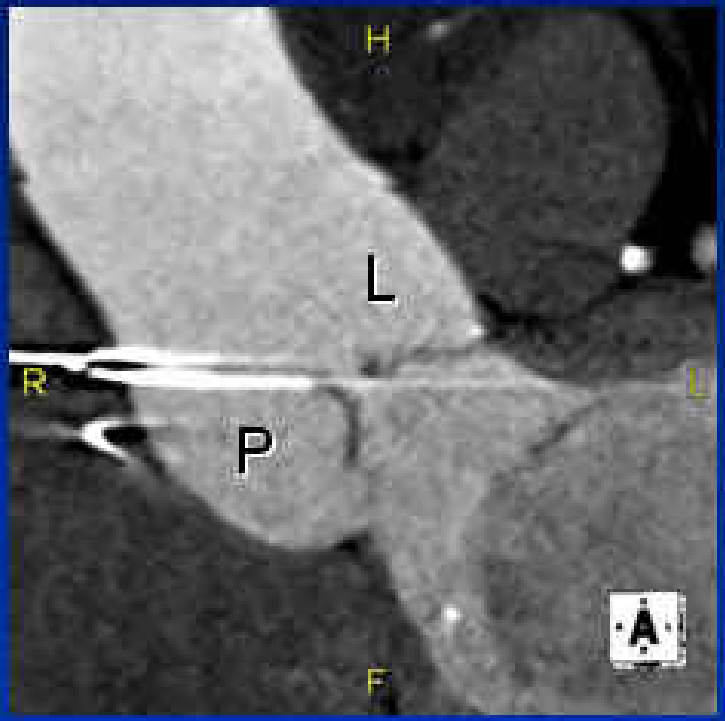
“Annulus” and V-A Junction

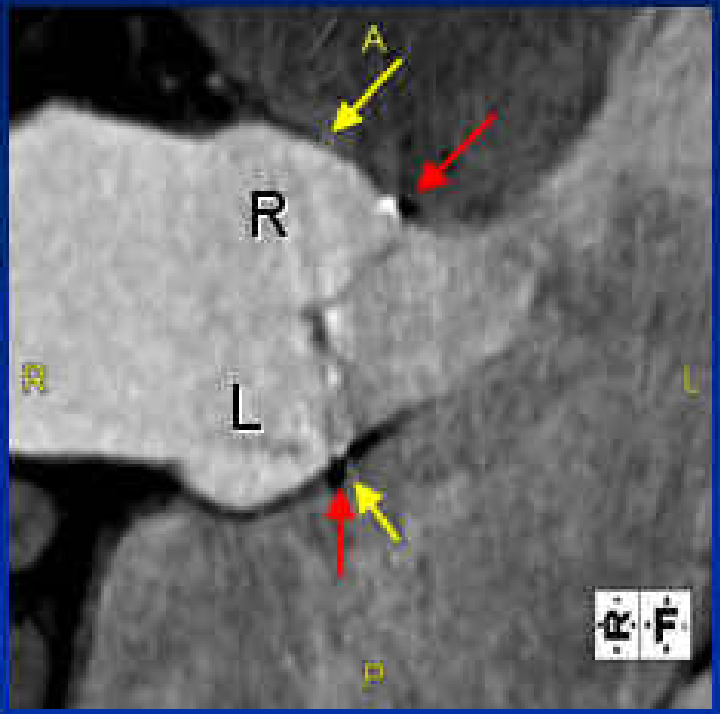


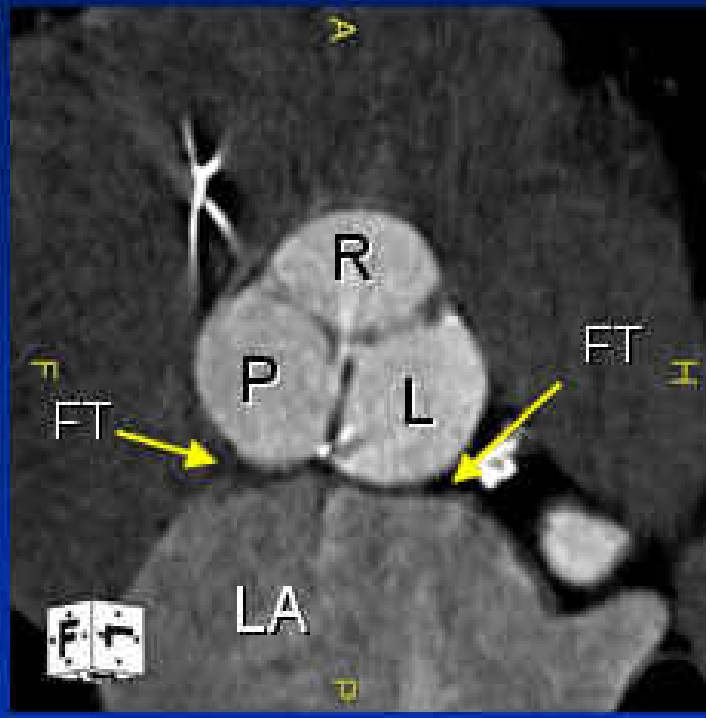


Piazza, N. et al. Circ Cardiovasc Intervent 2008;1:74-81

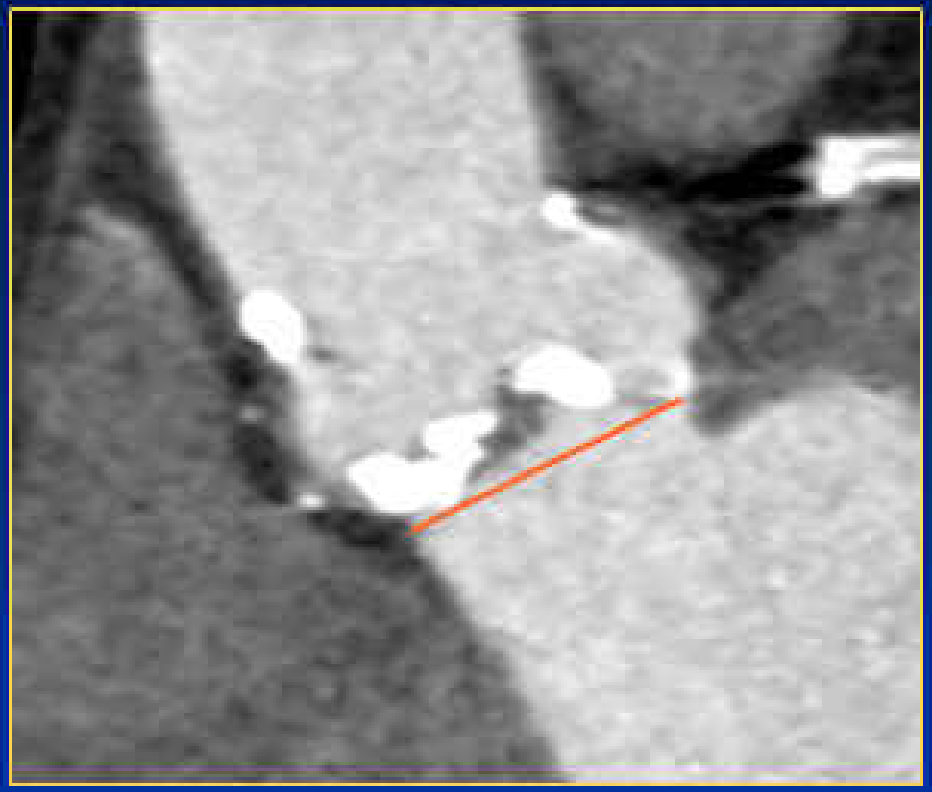
Anatomy of the Aortic Valve







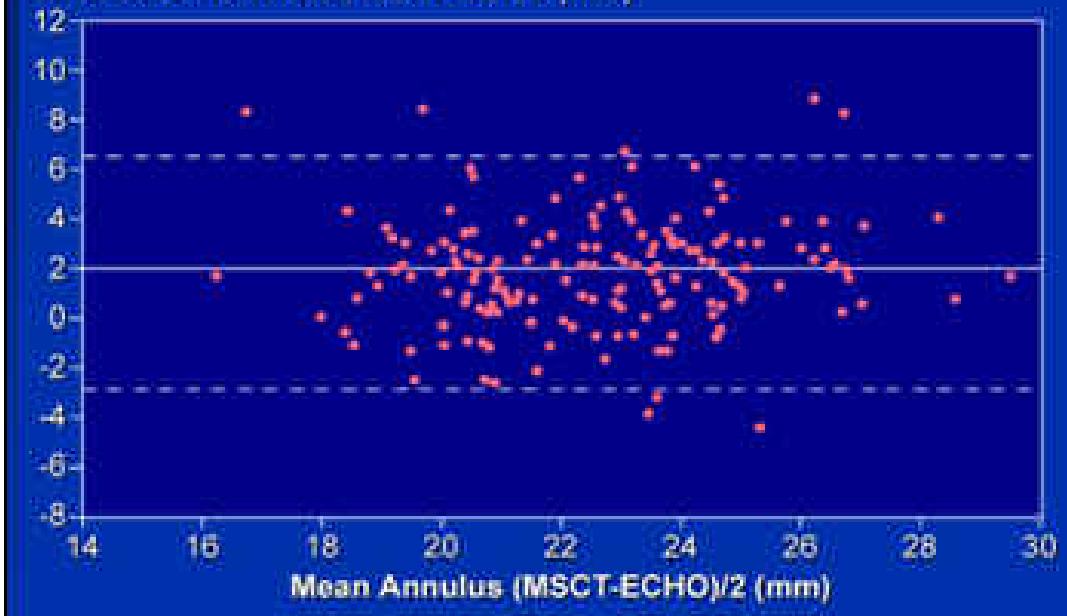
“Annulus” Size by CT and TEE



Correlation dependent on
- TEE quality
- Same diameter measurement
- Similar part of cardiac cycle

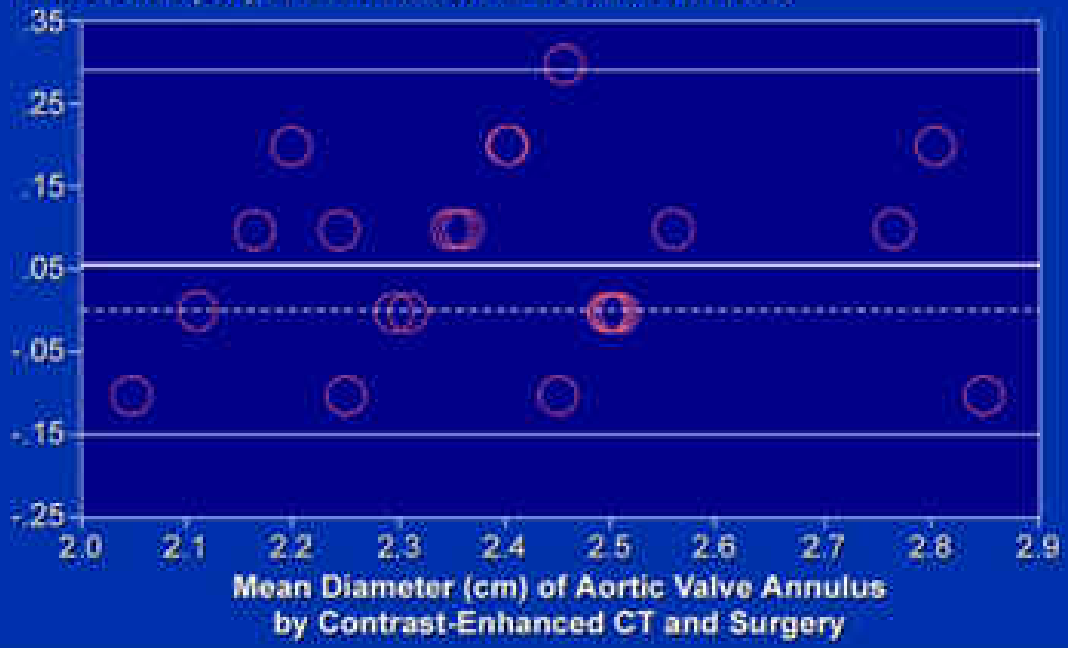
Accuracy of MSCT in Annulus Measurement

MSCT and Echo Agreement



Tops et al JACC Img. 2008;1:321-330

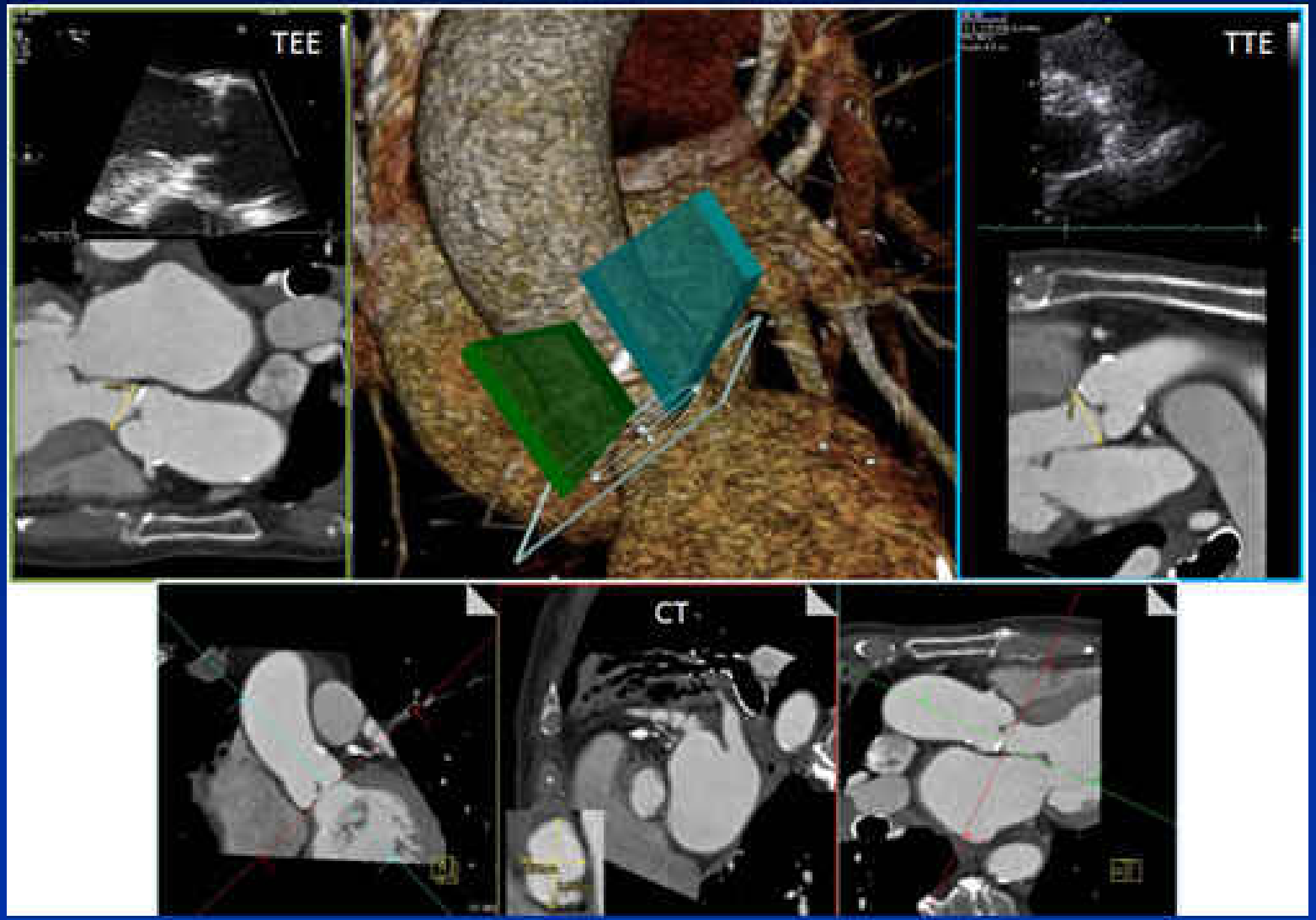
MSCT and Anatomy Agreement



Willmann et al Radiology. 2002;225:120-128

Annulus Measurement

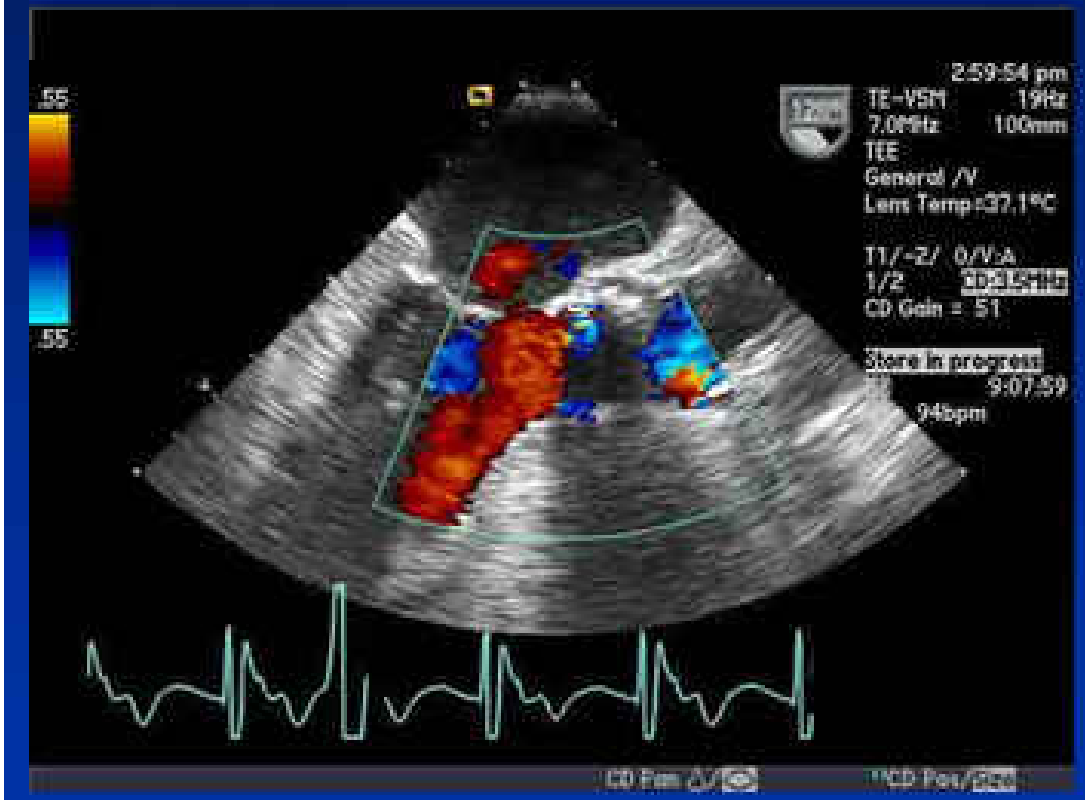
Different Imaging Modalities

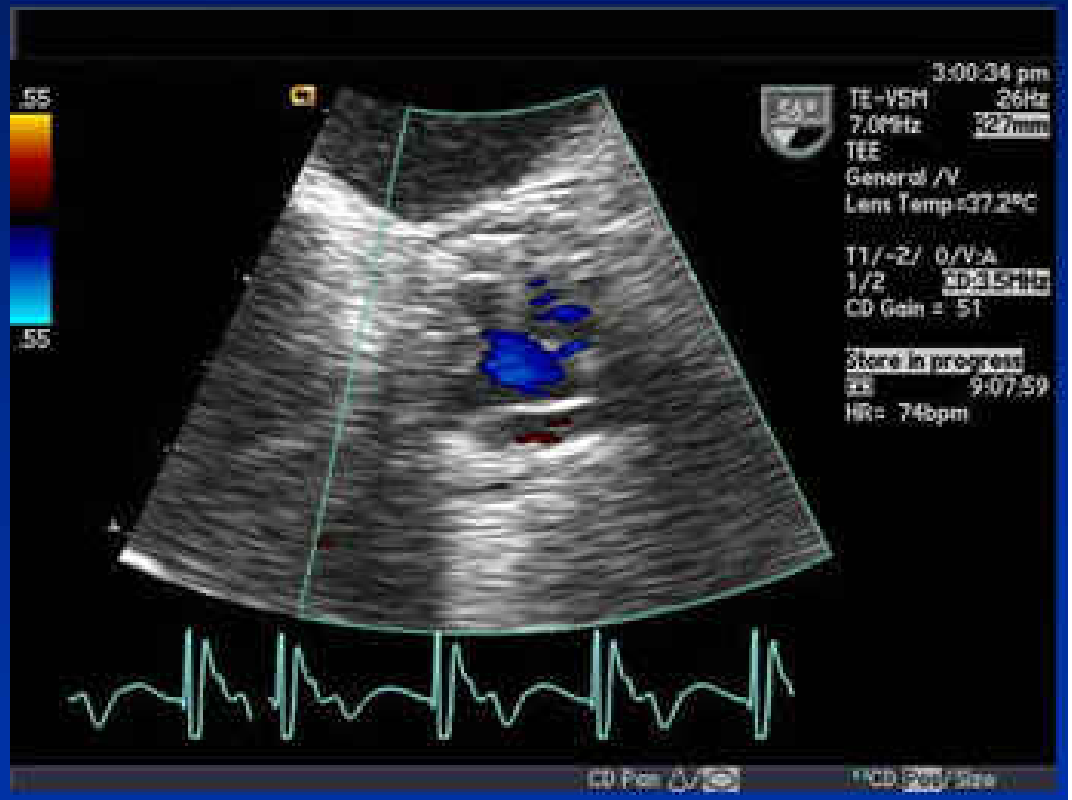


Tuzcu, Kapadia and Schoenhagen, JACC, *in press*

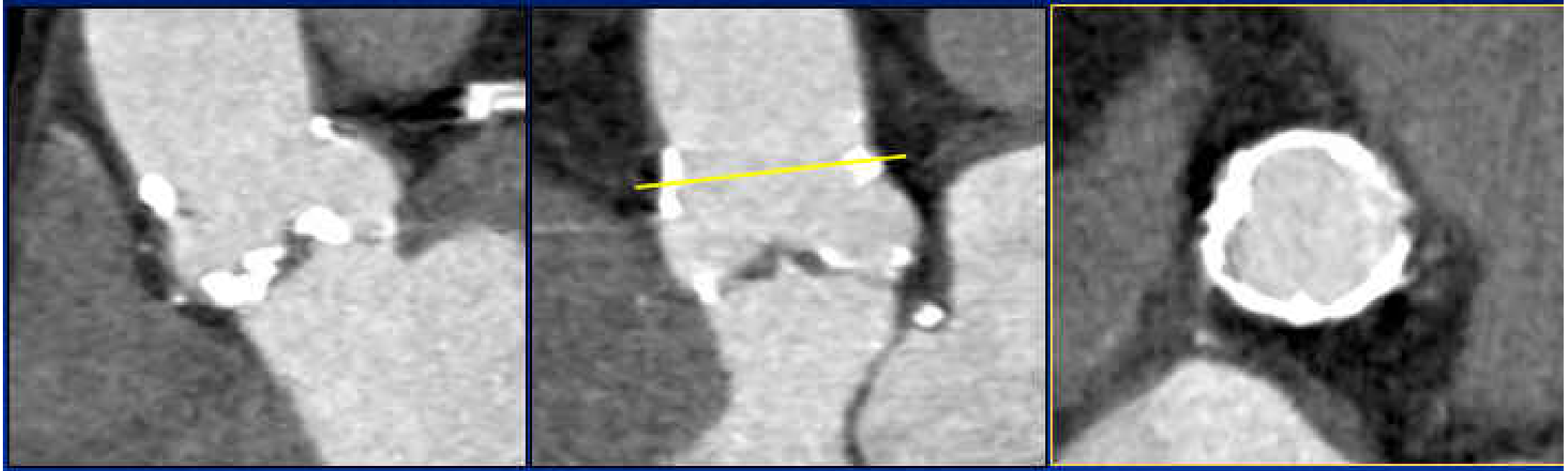
Patterns of Calcification

Is There a Relationship with AI





Patterns of Calcification

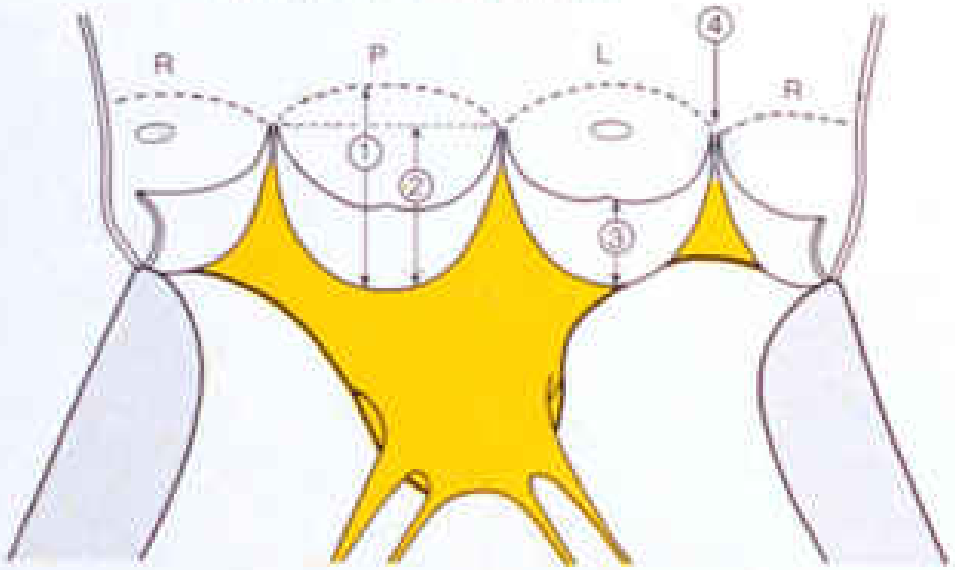


Significant ST Junction Calcification

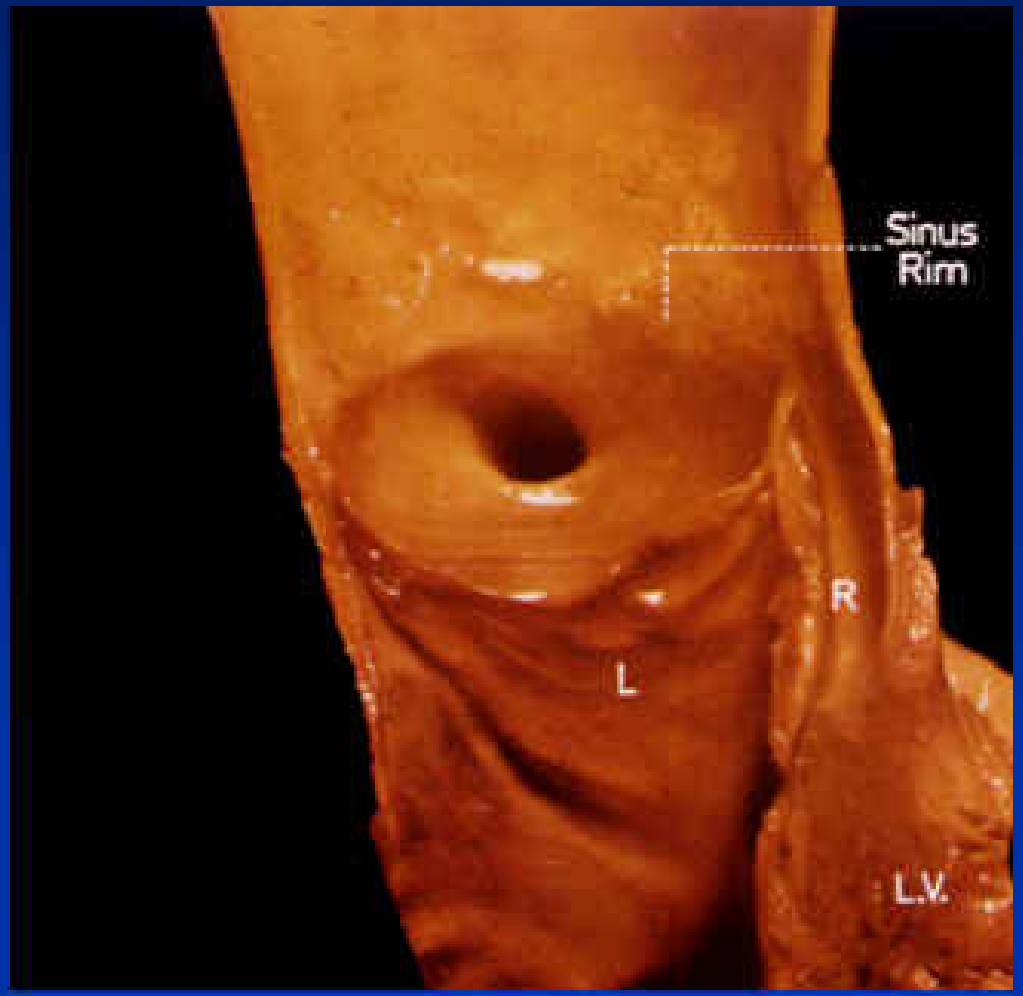
Ventricular movement of the balloon with stent deployment leading to valve embolization in the ventricle

Cusp Anatomy and Coronary Ostia

DATA FROM 100 SPECIMENS



	MEAN (mm)	S. D.
①	23.2	2.7
②	18.5	2.5
③	13.5	1.8
④	6.1	2.0



Aortic Root Measurements

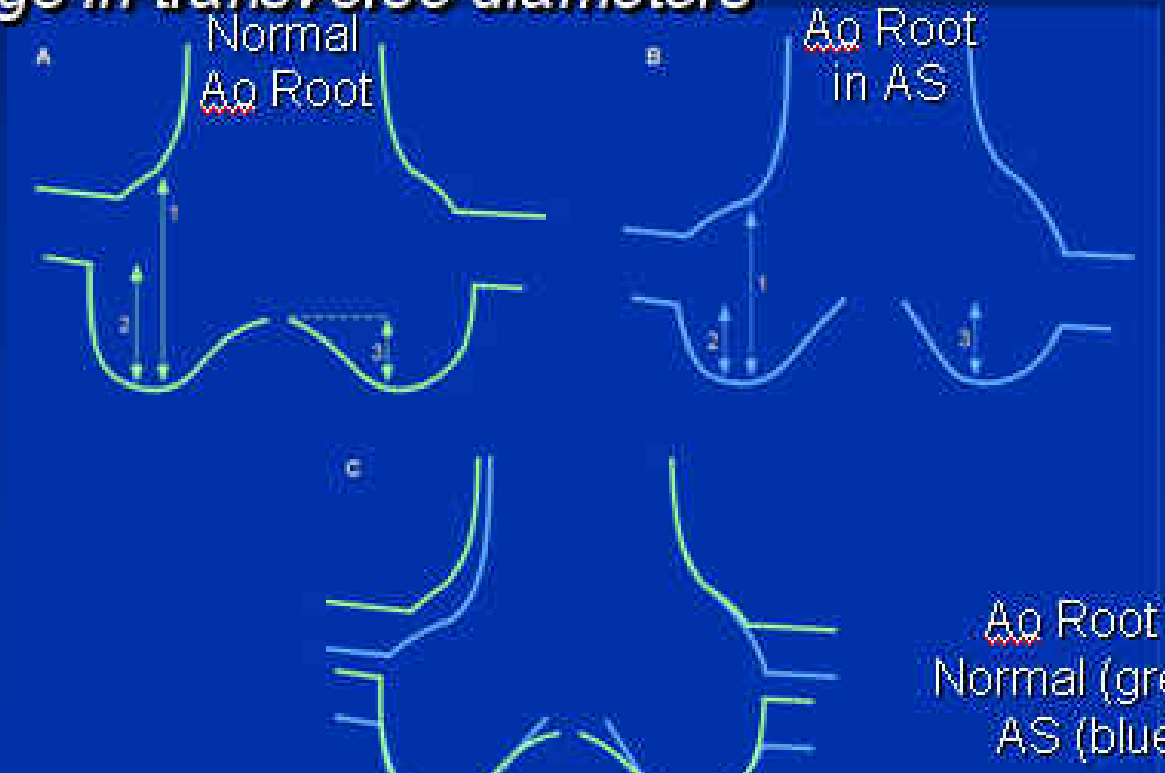
- **Compared to elderly gender matched controls,** patients with AS have:
  - Reduced distances from annulus to right and left coronary artery ostia
  - Reduced distance from annulus to sinotubular junction
- There is no change in the transverse diameters of the aortic root

Variable	Aortic Stenosis (n=25)	Control (n=25)	p-value
Annulus to RCA (mm)	13.6 ± 2.8	15.2 ± 2.5	0.04
Annulus to LCA (mm)	13.4 ± 3.2	15.6 ± 2.7	0.01
Annulus to ST junction (mm)	16.7 ± 2.0	21.0 ± 2.3	<0.01
LVOT (mm)	24.6 ± 3.6	25.1 ± 3.0	0.65
Annulus (mm)	27.2 ± 3.5	27.2 ± 4.0	0.99
Aortic Sinus (mm)	34.7 ± 4.7	36.7 ± 5.3	0.17
ST Junction (mm)	27.1 ± 3.8	28.2 ± 4.7	0.40

Akhtar et al. J Thorac Cardiovasc Surg. 2009 Apr;137(4):950-6. Epub 2009 Feb 23

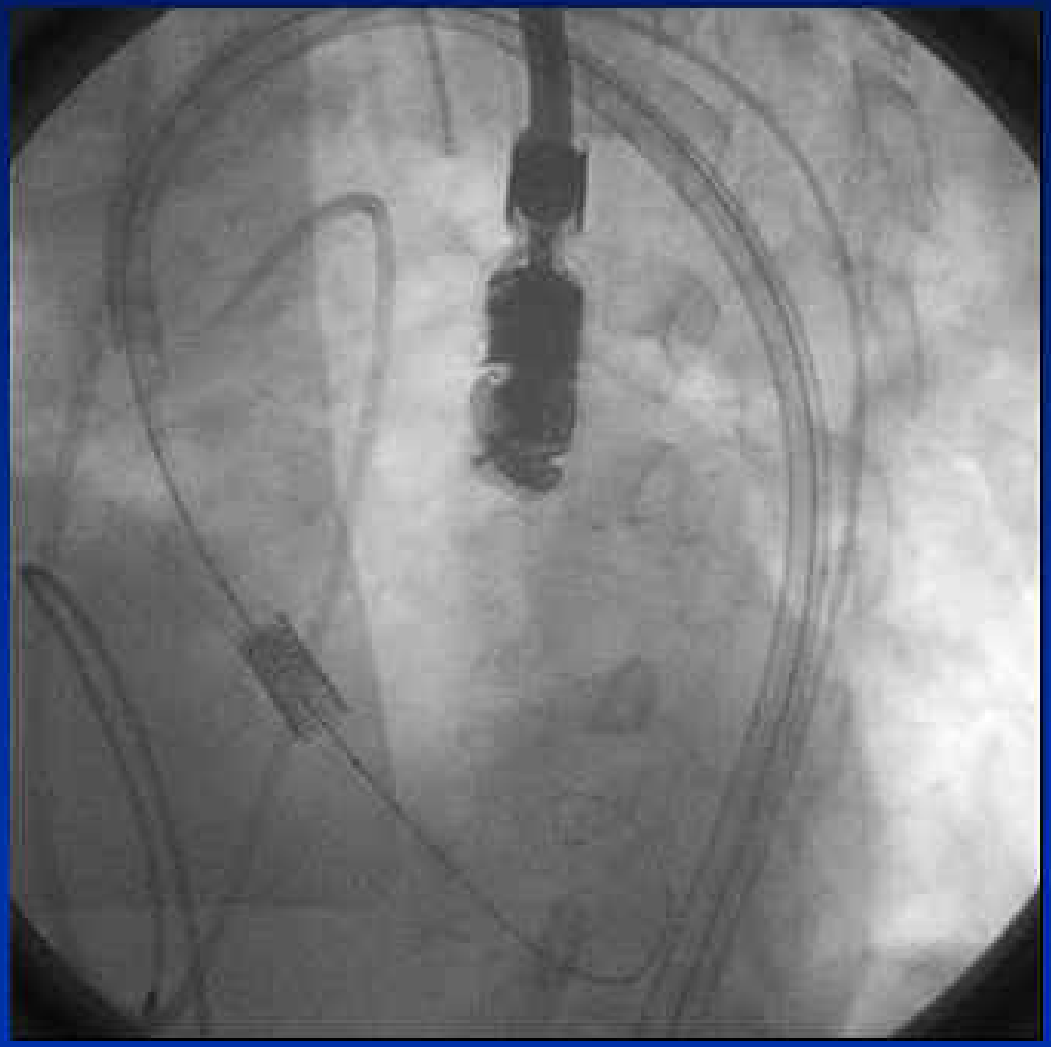
Summary of Data

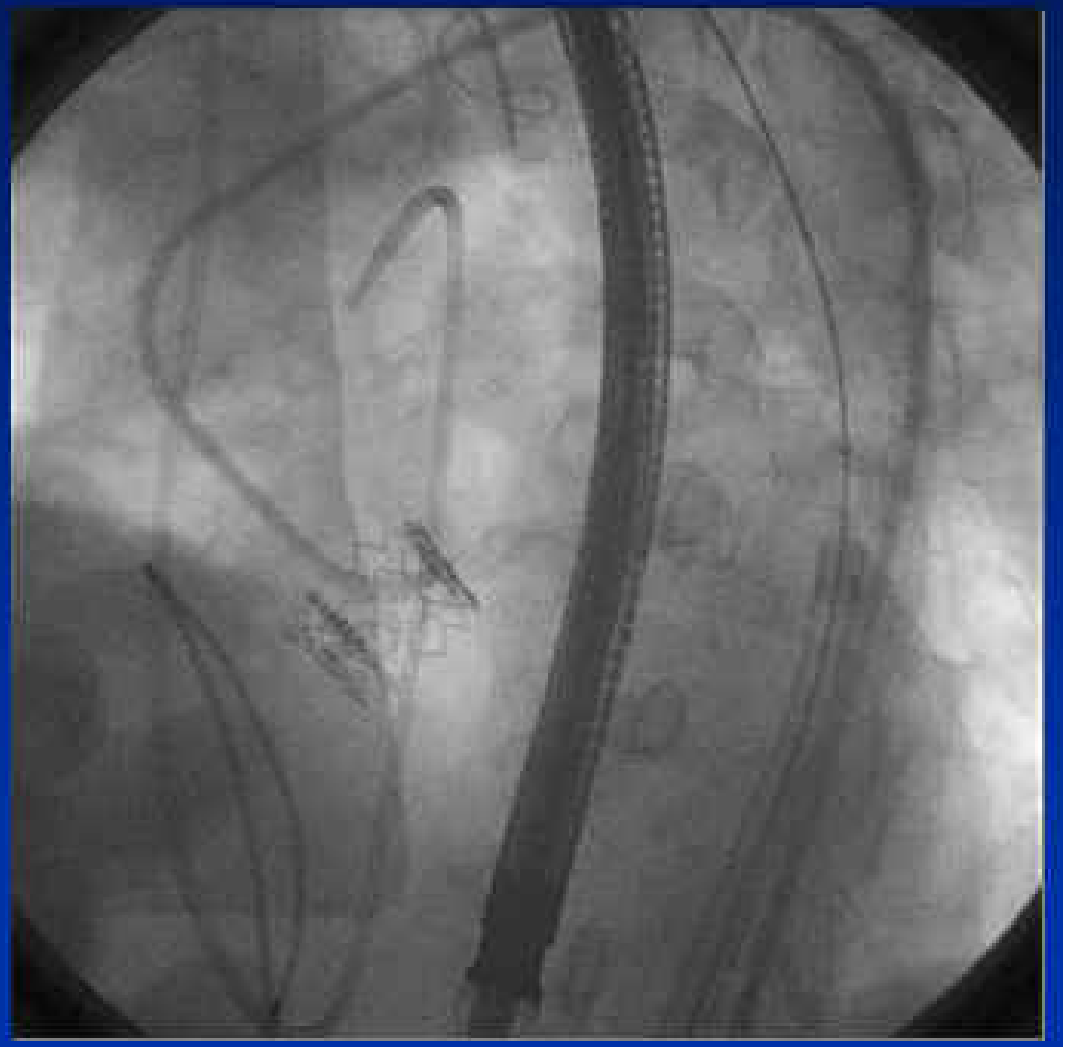
- *Longitudinal remodeling of the aortic root in calcific AS*
  - *Reduced distances from the AV annulus to the coronary ostia and sinotubular junction in subjects with AS*
  - *No change in transverse diameters*



Akhtar et al. J Thorac Cardiovasc Surg. 2009 Apr;137(4):950-6. Epub 2009 Feb 23

Percutaneous Aortic Valve Replacement



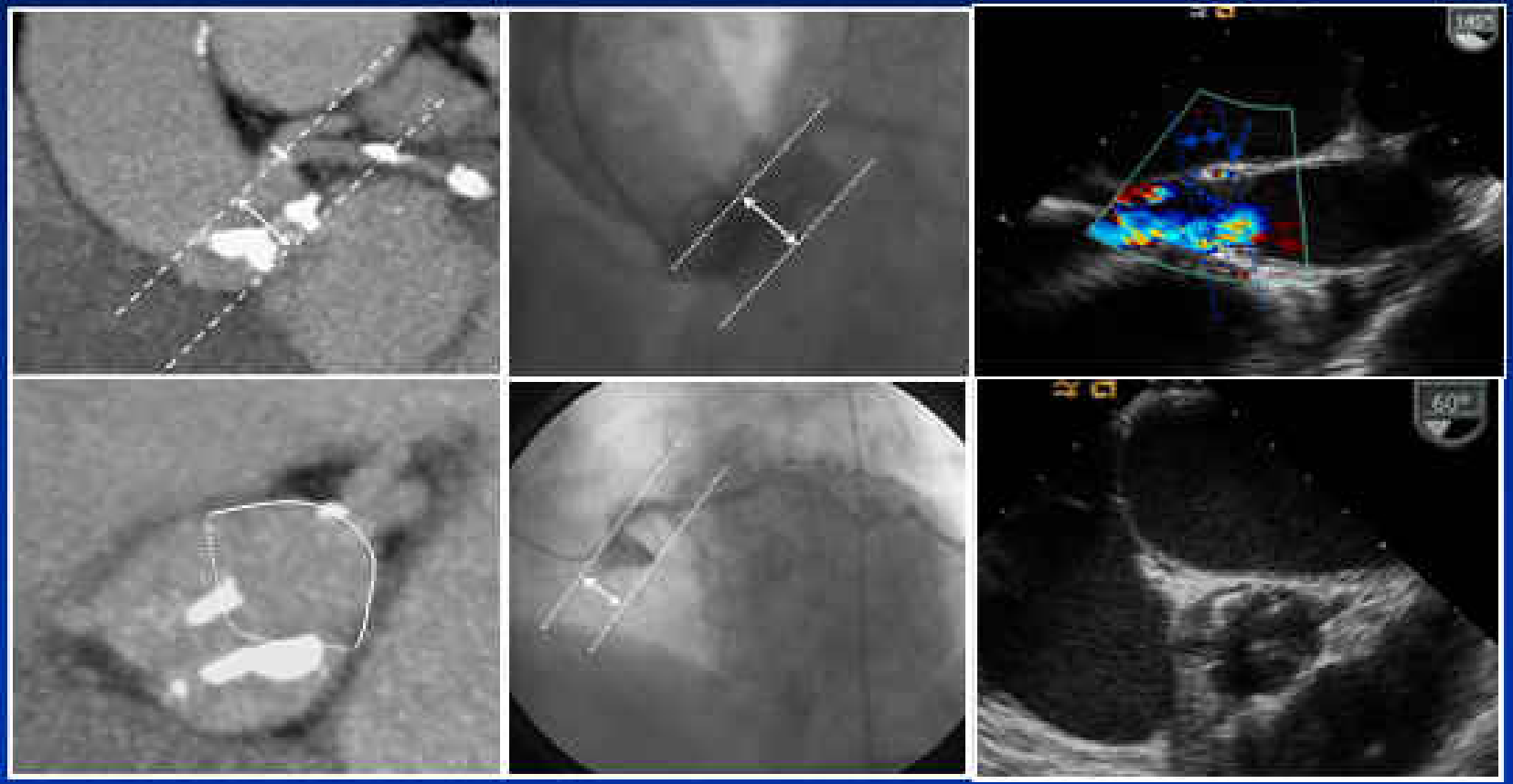


Kapadia SR et al, Catheter Cardiovasc Interv. 2009 Jun 1;73(7):966-72

Final Result: Stents in the Left Main

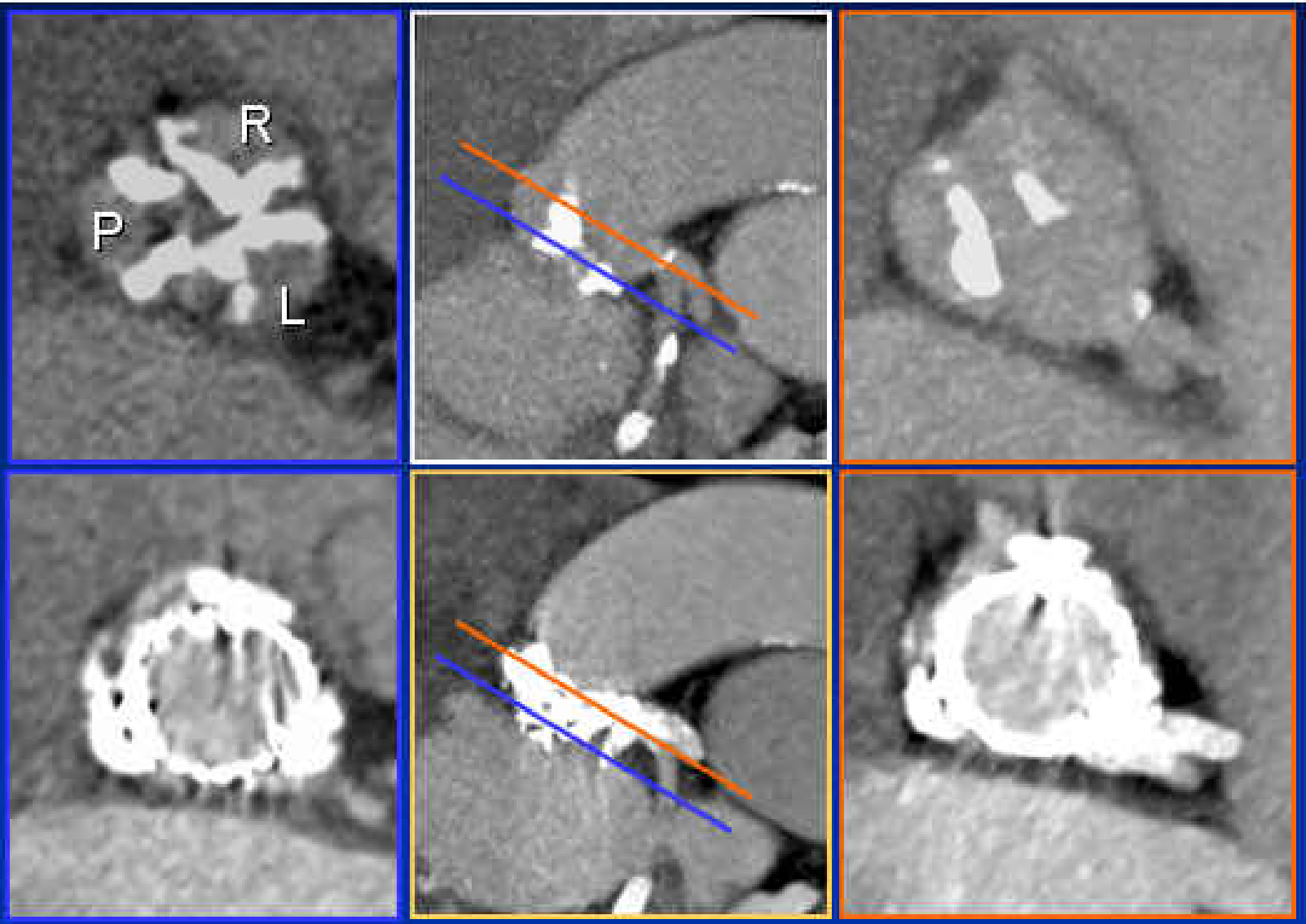
Kapadia SR et al, Catheter Cardiovasc Interv. 2009 Jun 1;73(7):966-72

LMT Origin and Aortic Valve

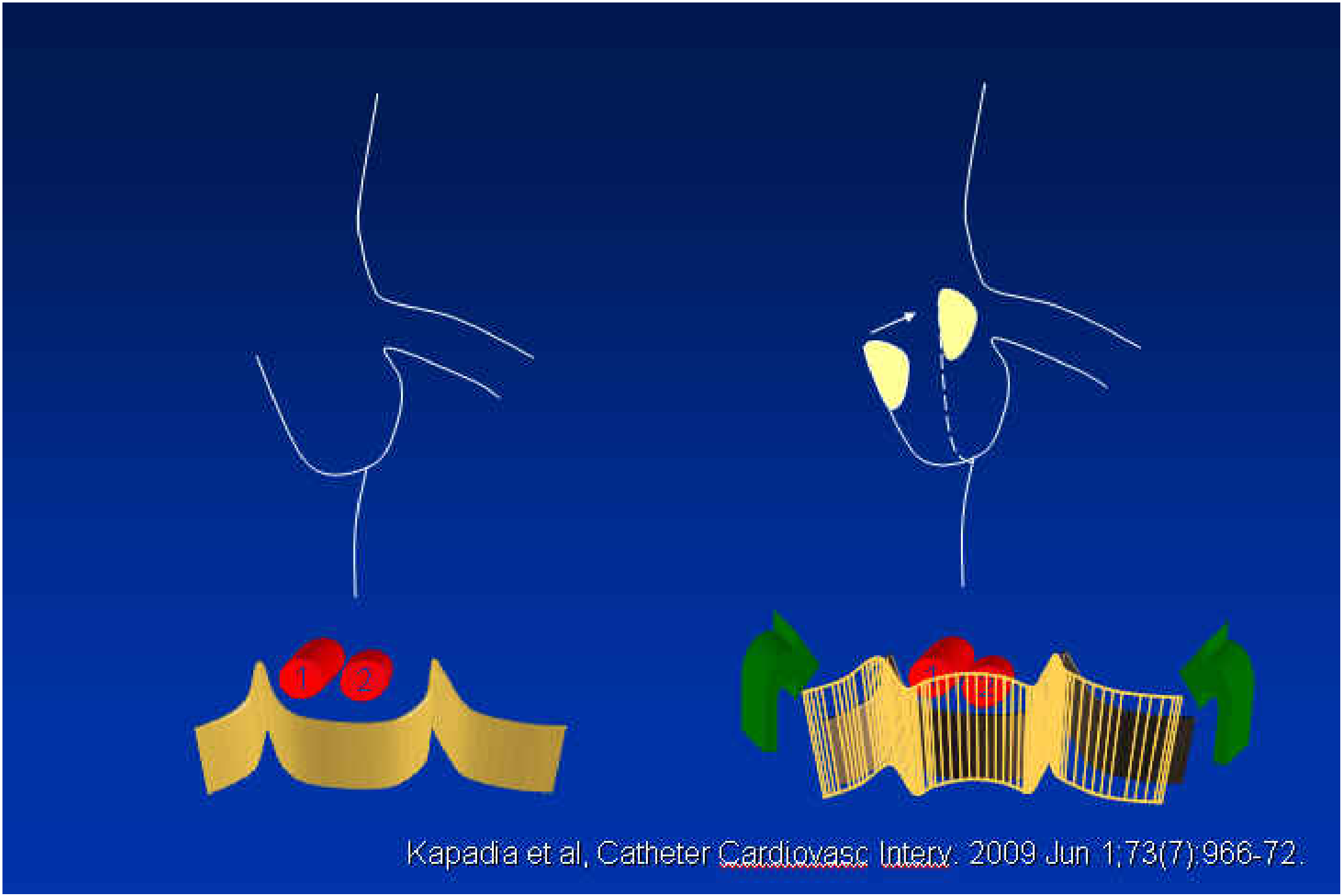


Kapadia et al, Catheter Cardiovasc Interv. 2009 Jun 1;73(7):966-72.

CT Scan Before and After LMT Occlusion

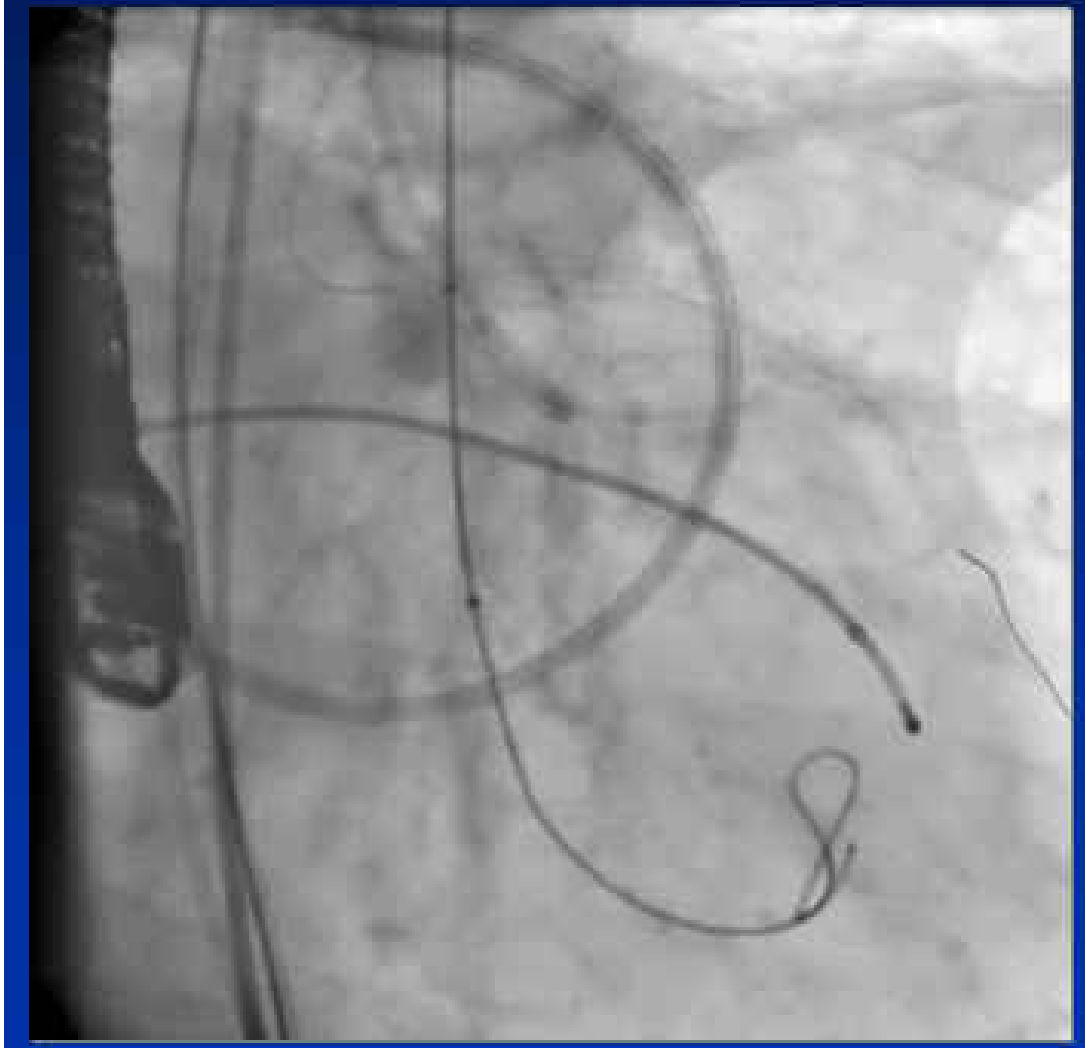


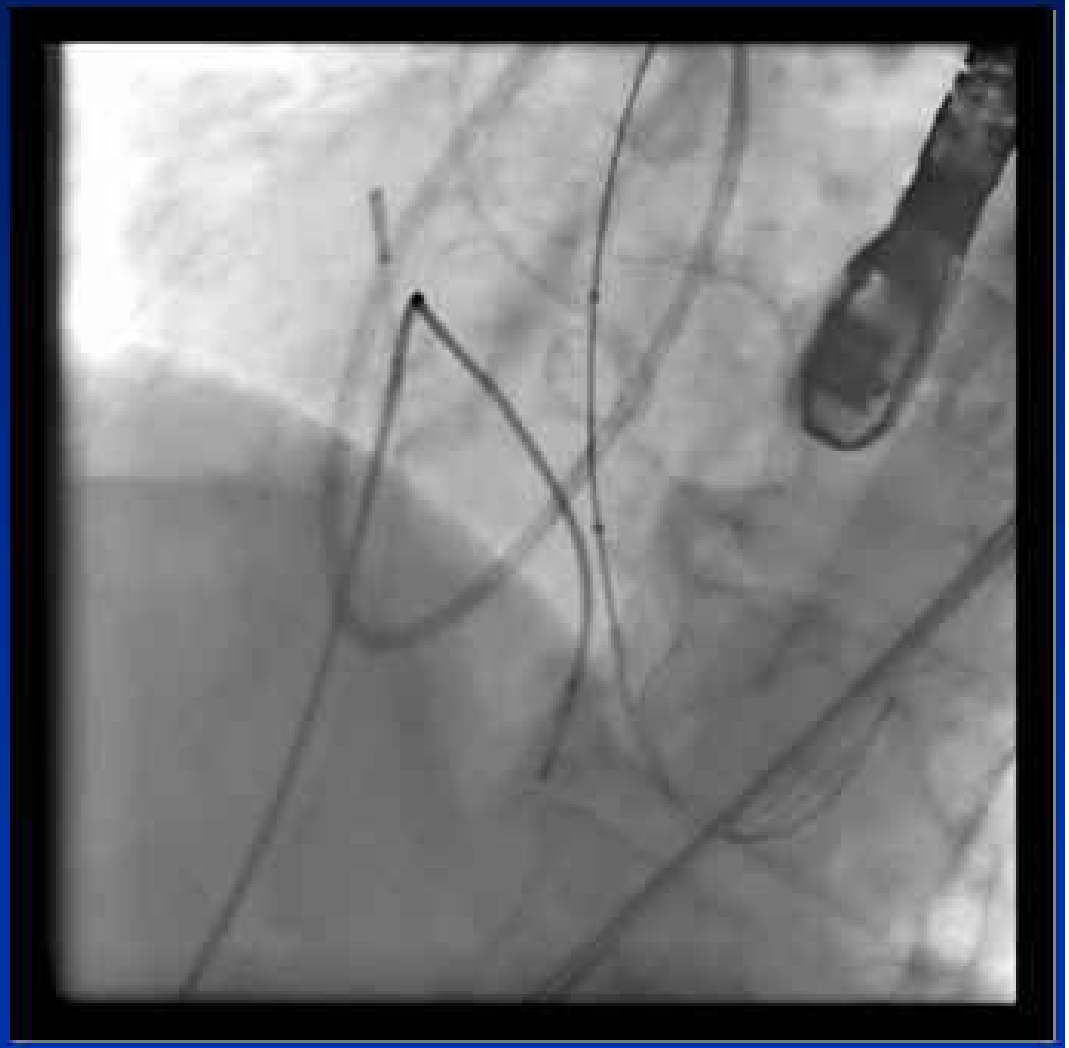
Kapadia et al, Catheter Cardiovasc Interv. 2009 Jun 1;73(7):966-72.



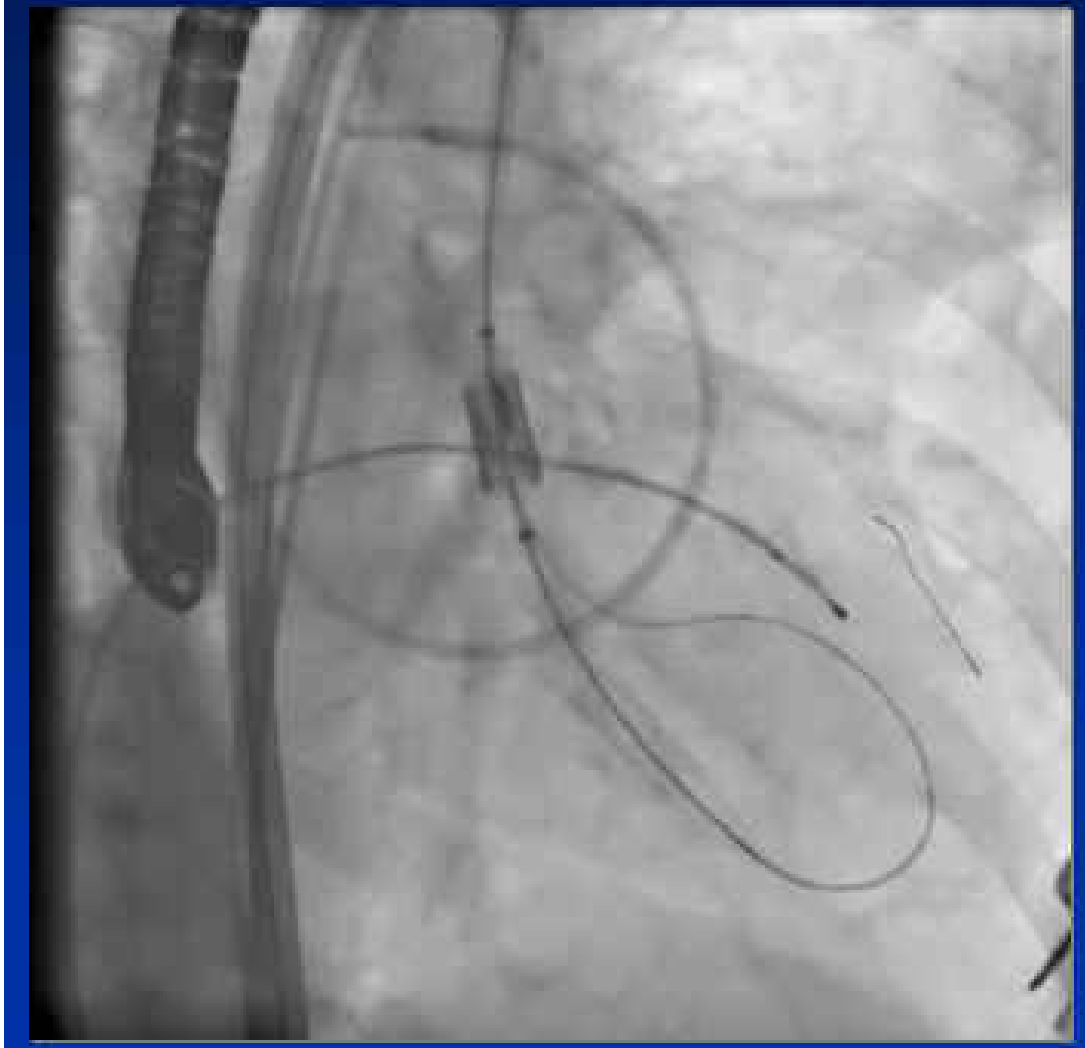
Kapadia et al, Catheter Cardiovasc Interv. 2009 Jun 1;73(7):966-72.

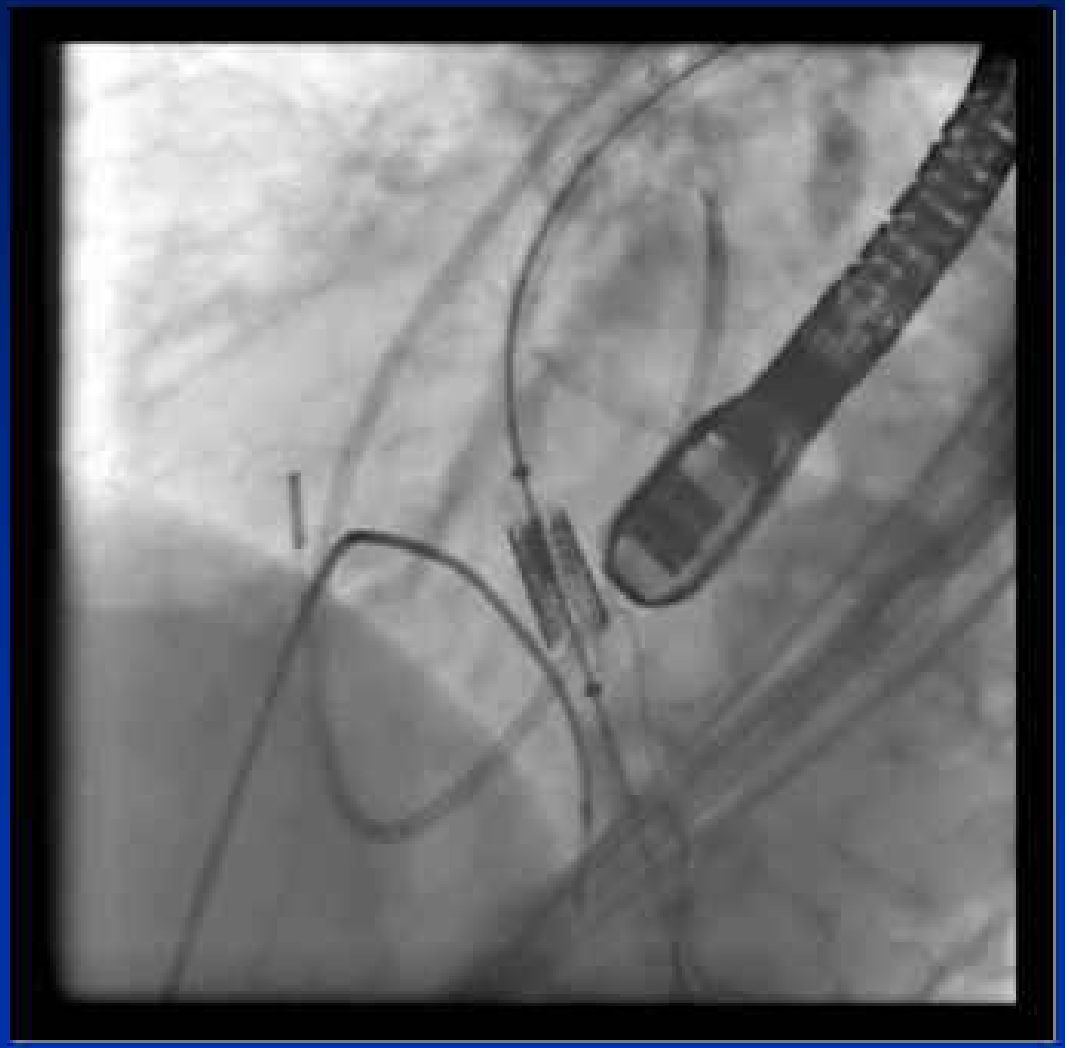
Injection with BAV



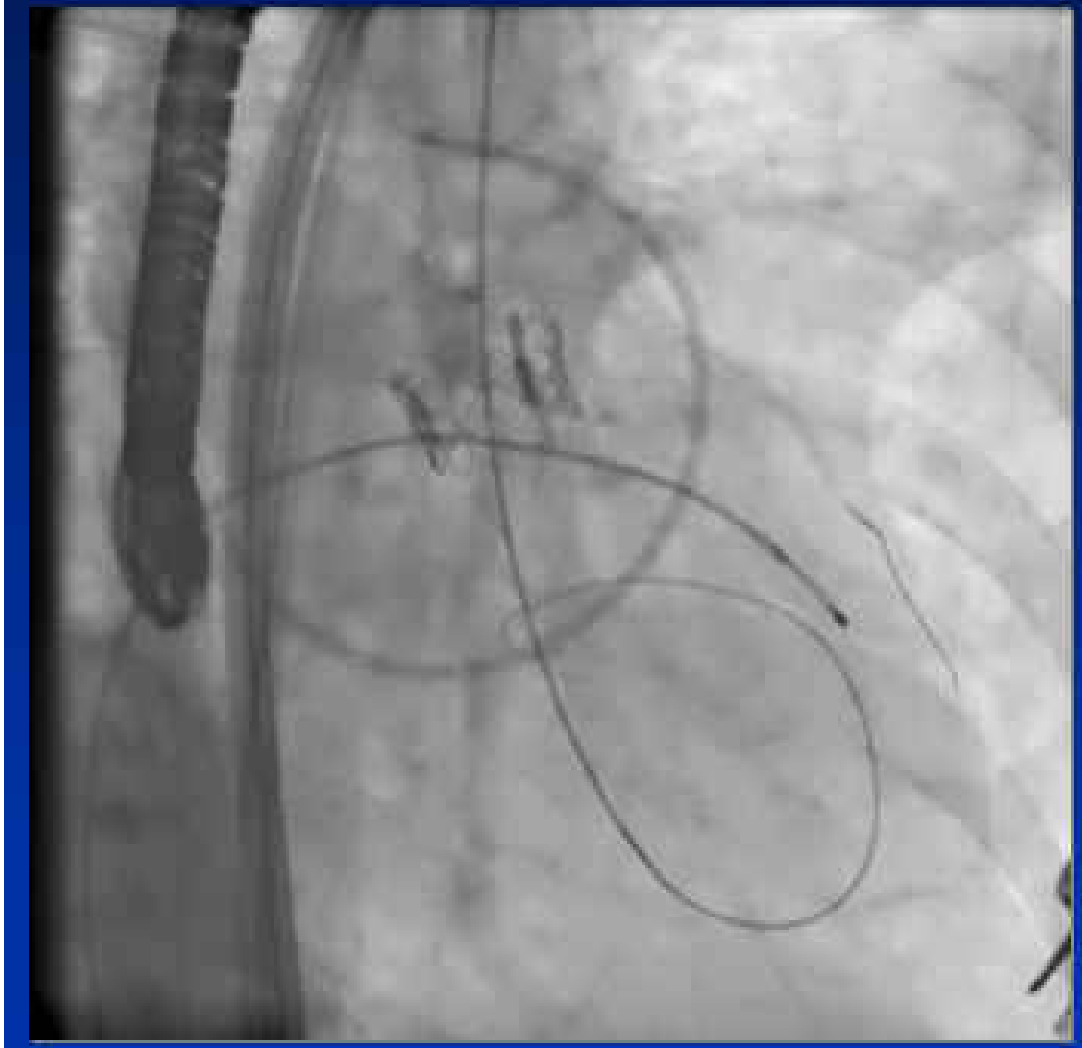


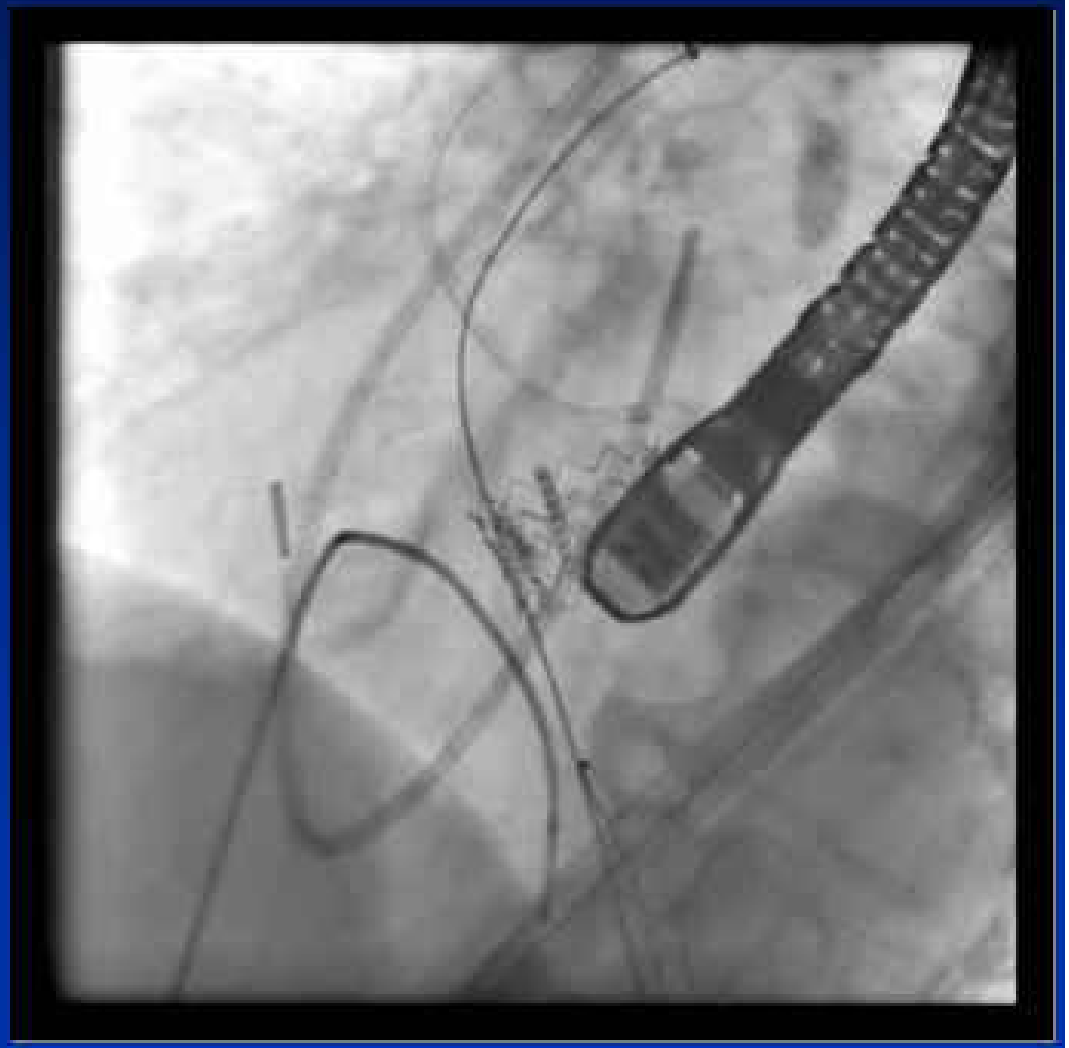
Valve Deployment with Wire





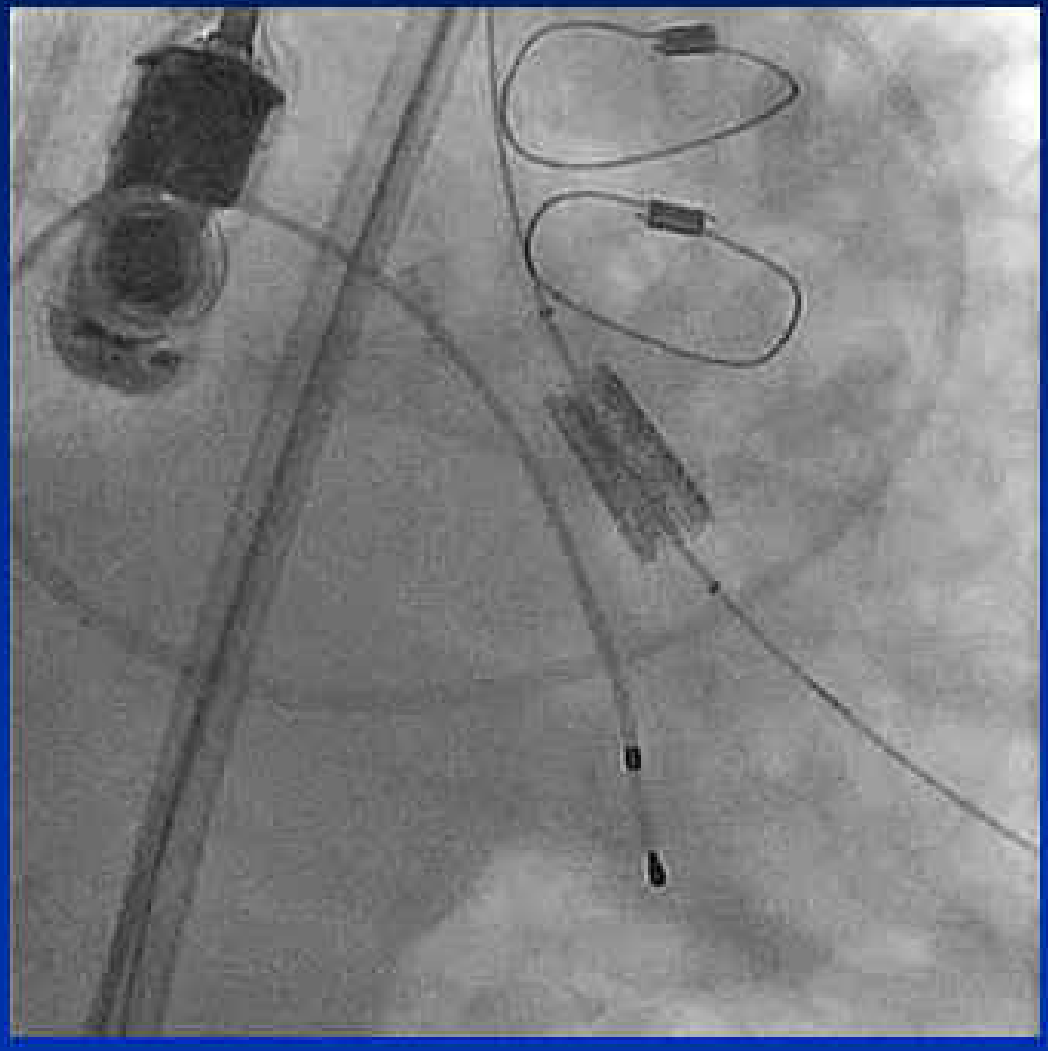
Coronary un-compromised

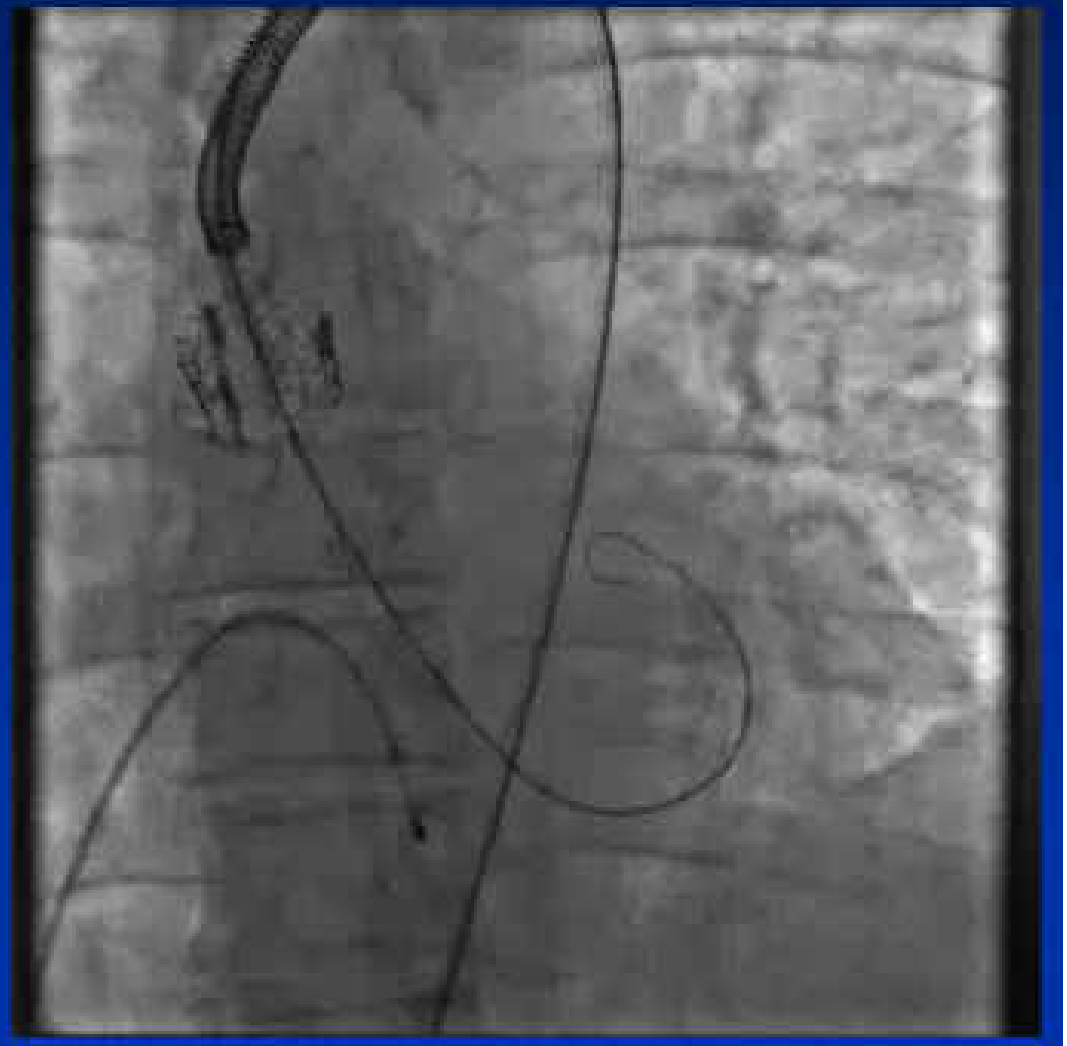




How To Prevent Malpositioning?

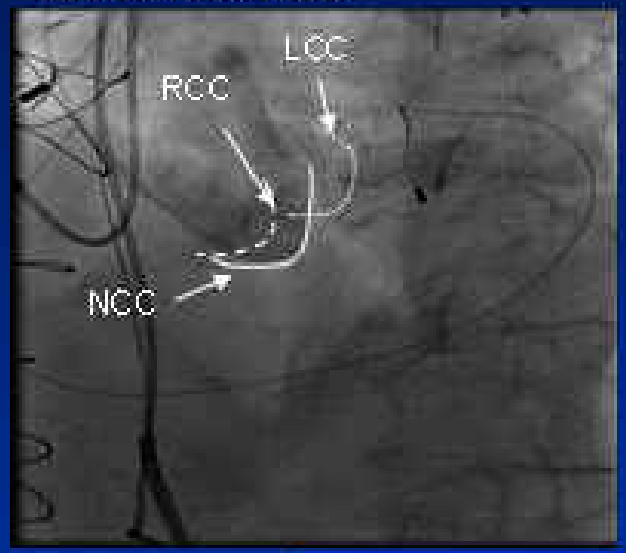
Stent Length is 14-16 mm, there is one chance!



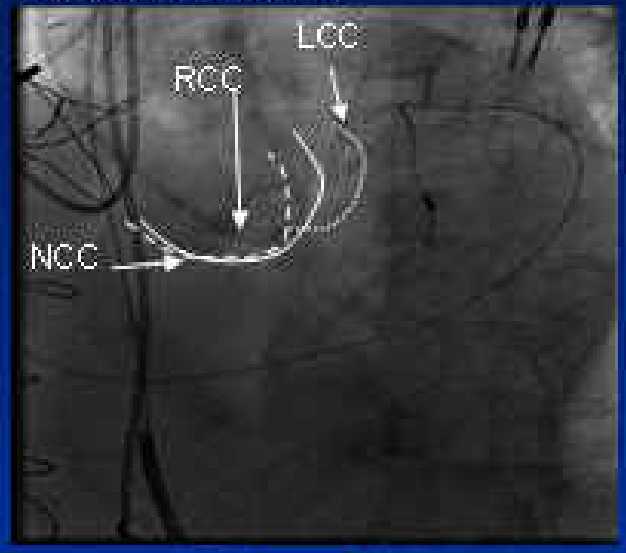


Selection of Fluoroscopic Projections

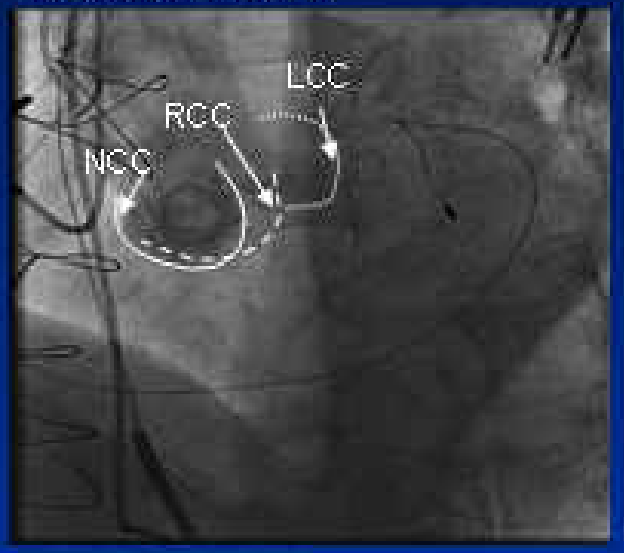
LAO 40 Cr 20

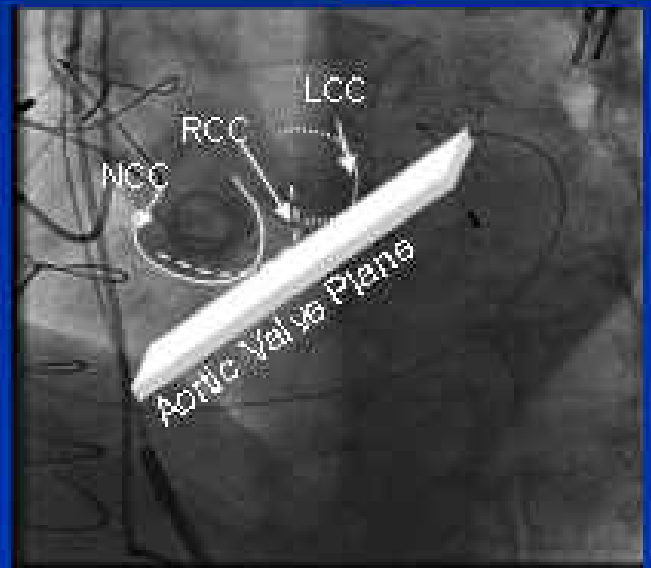


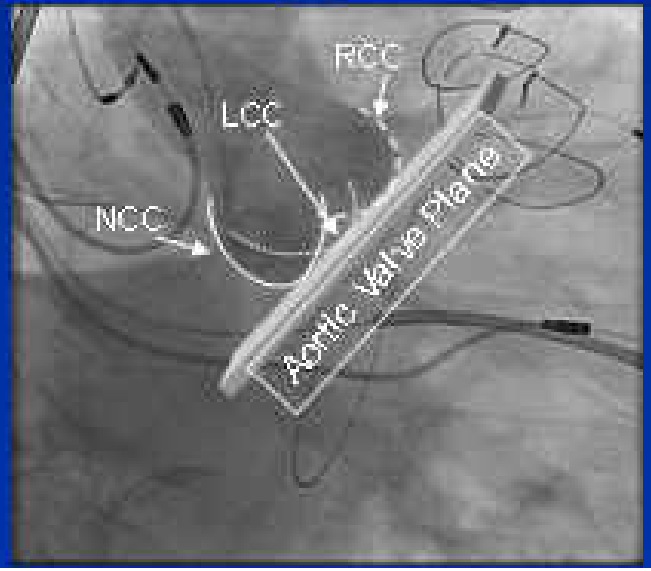
LAO 40 Cr 30



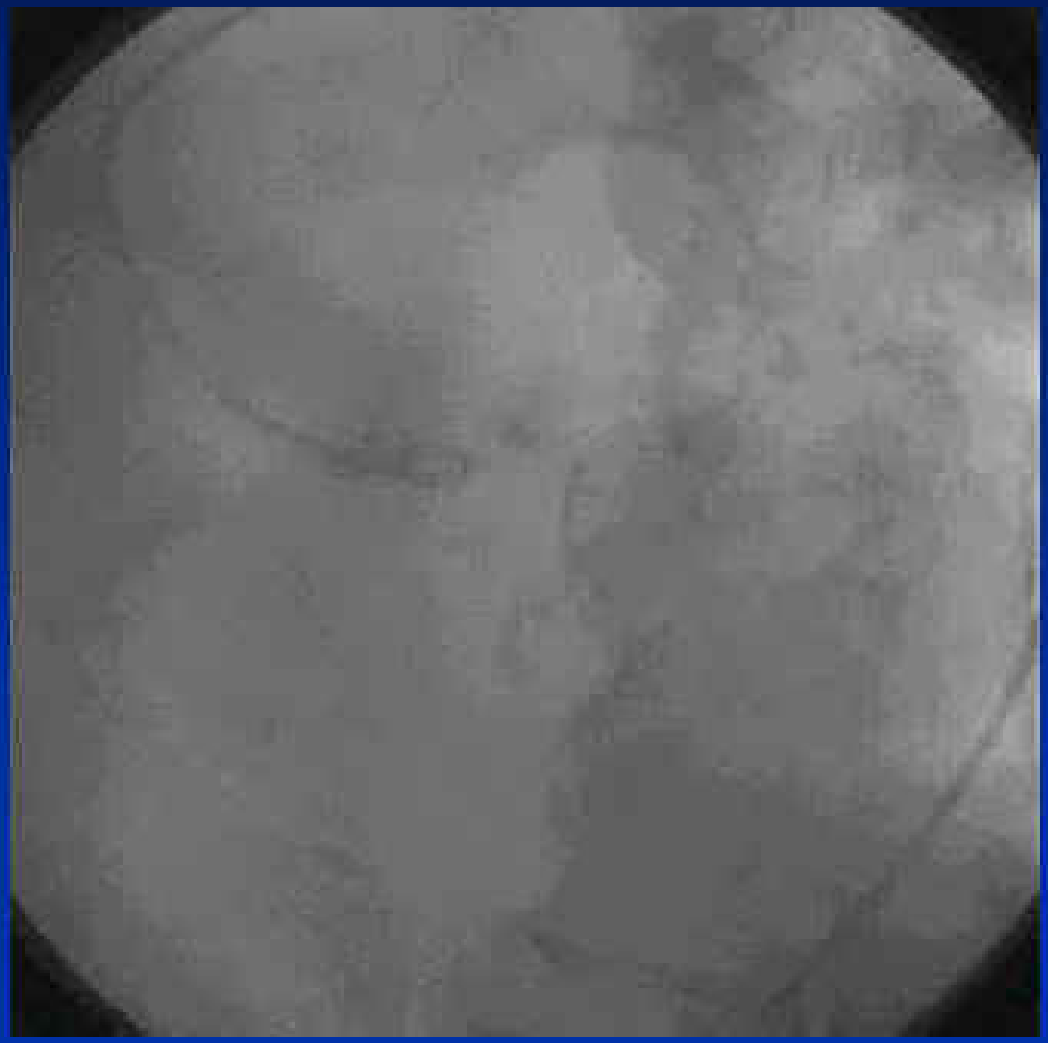
LAO 30 Cr 30

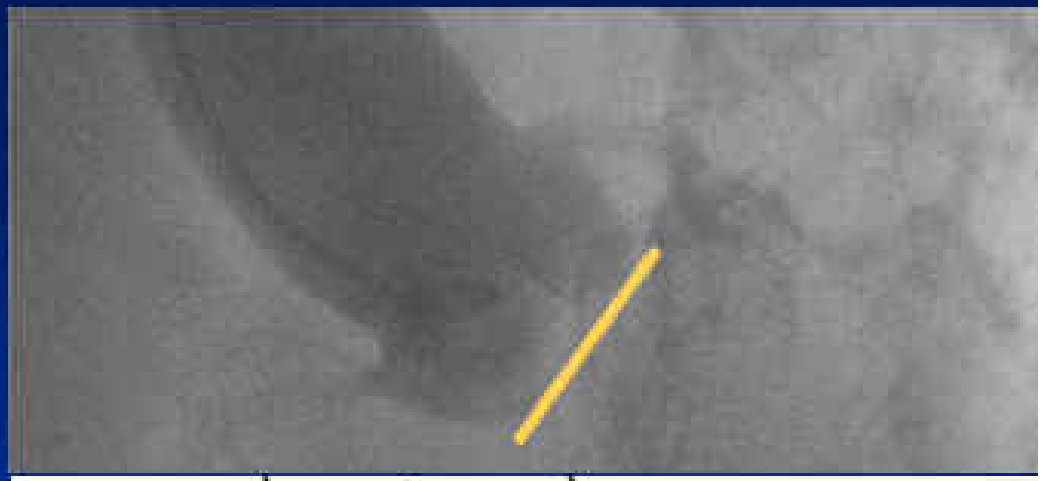


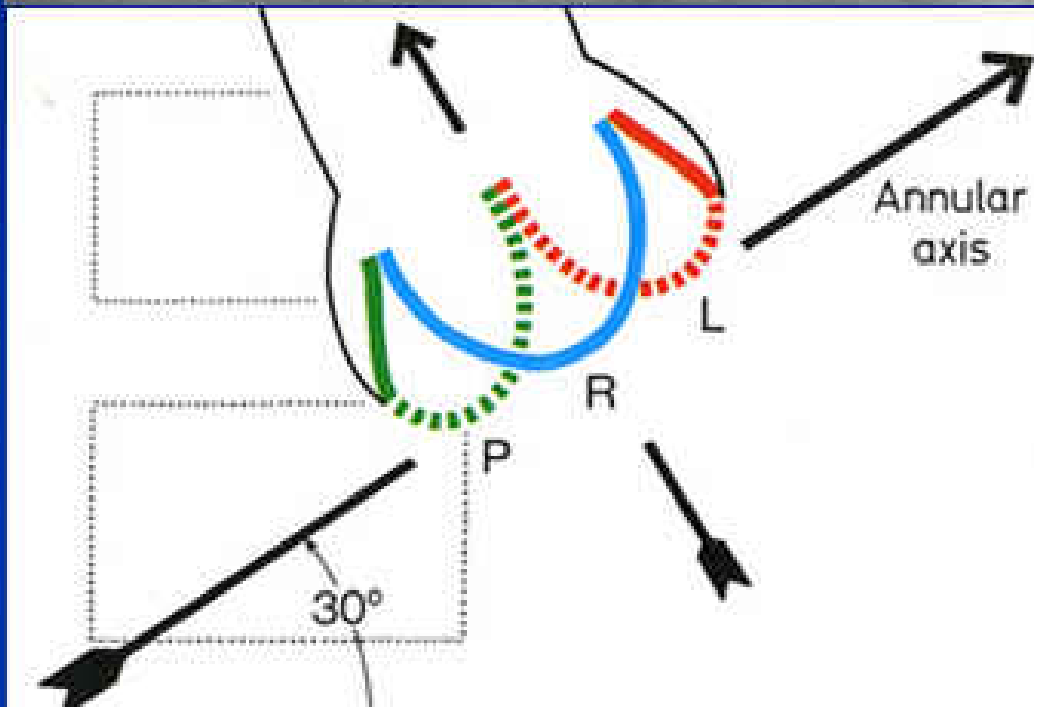


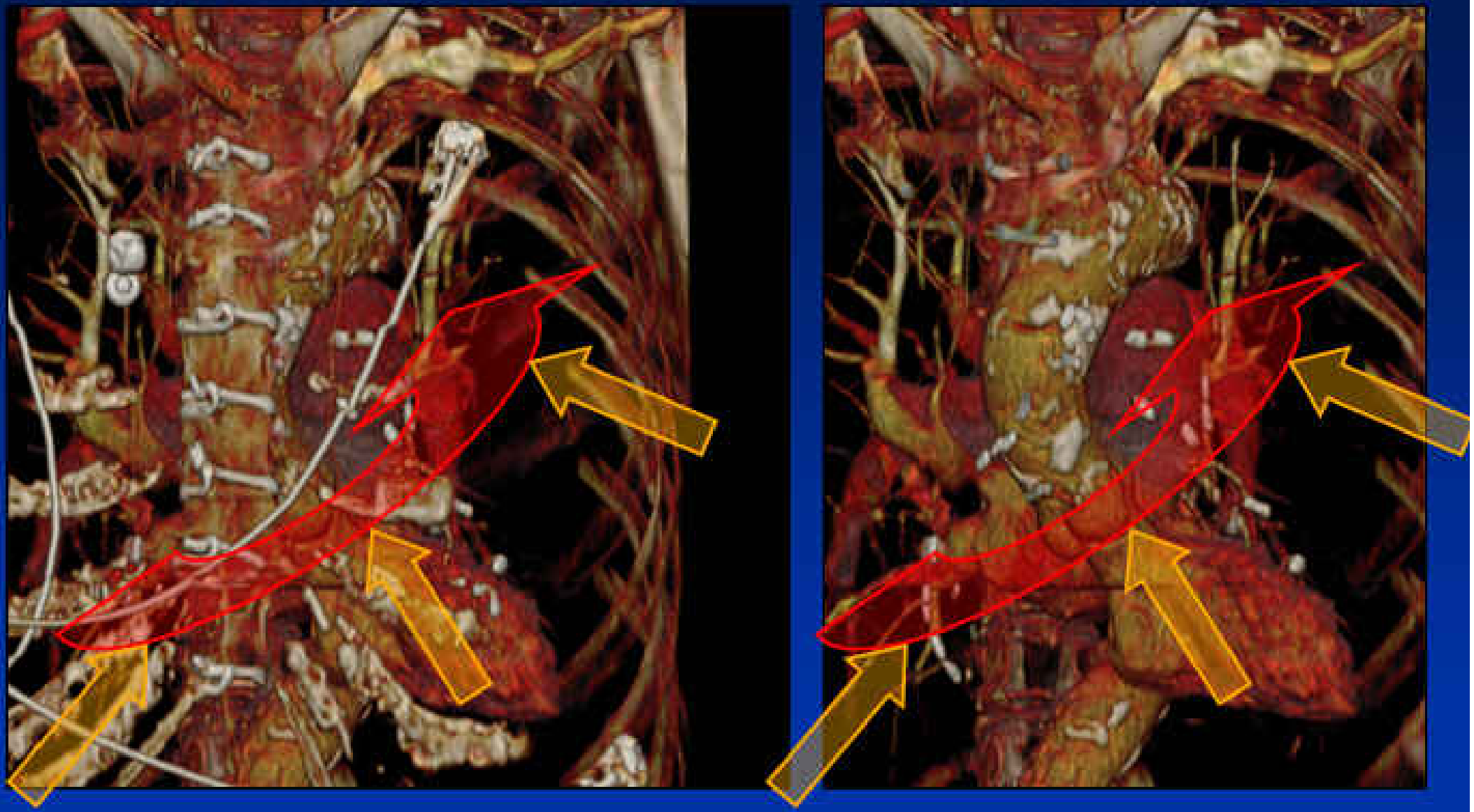


Pre-procedure Angiography

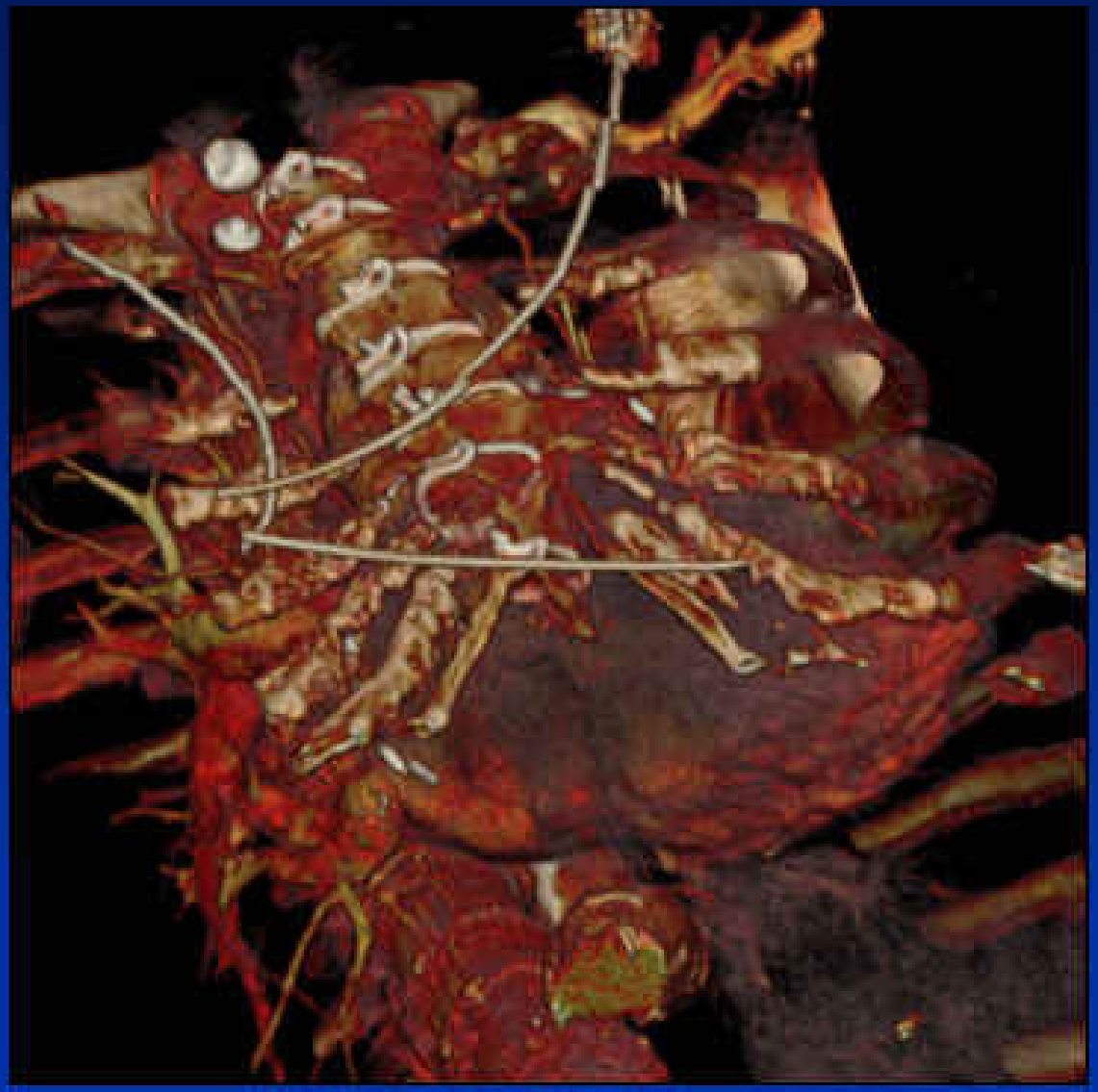


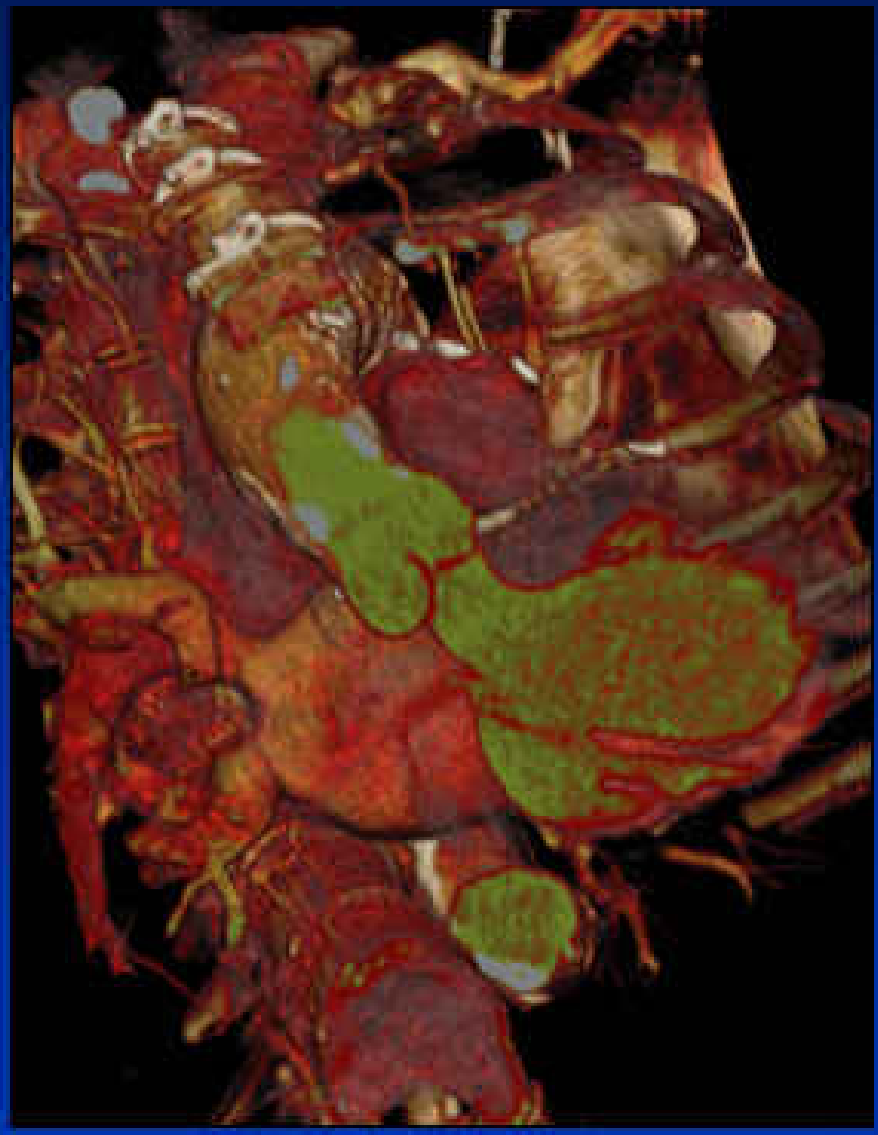




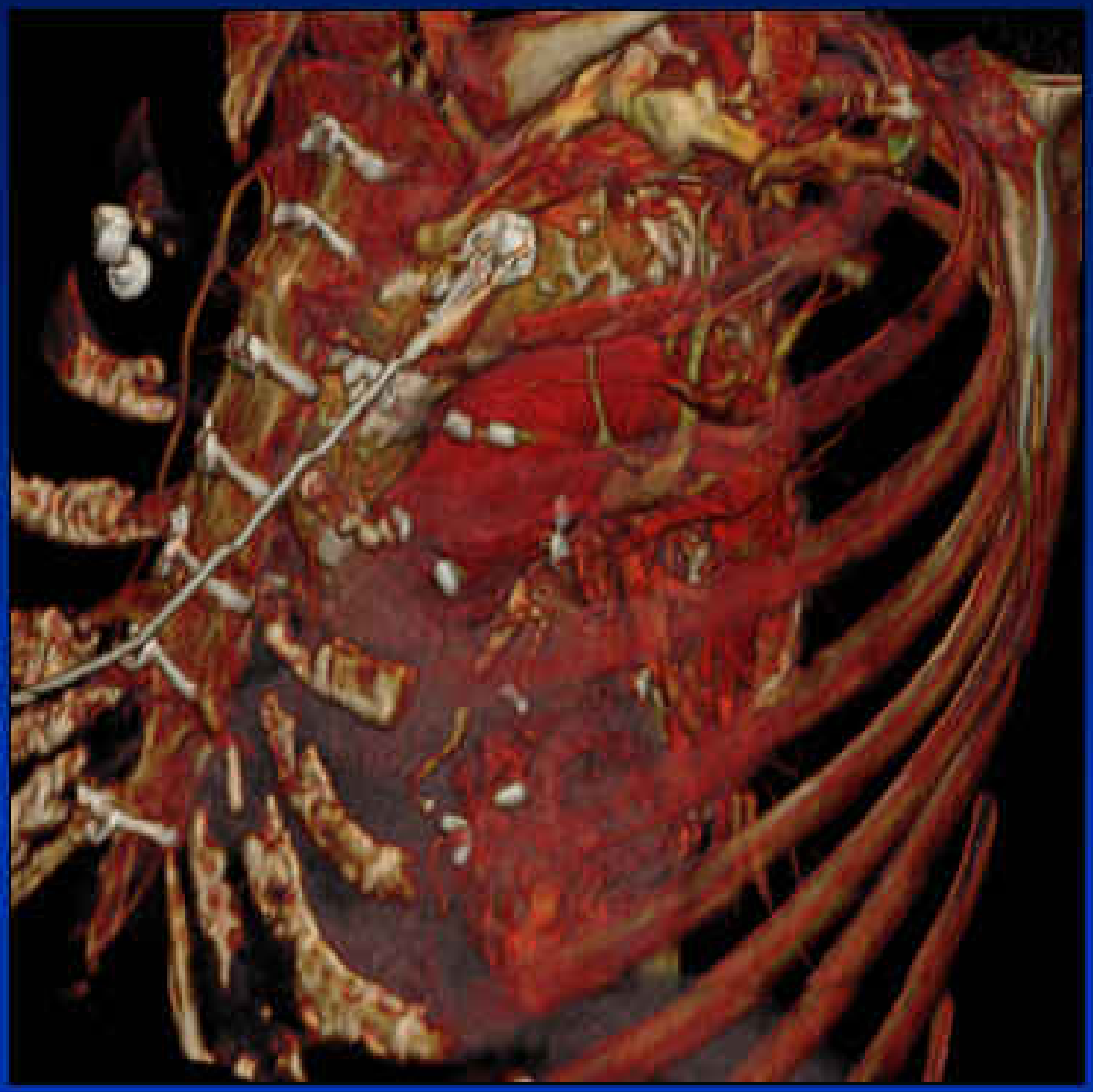


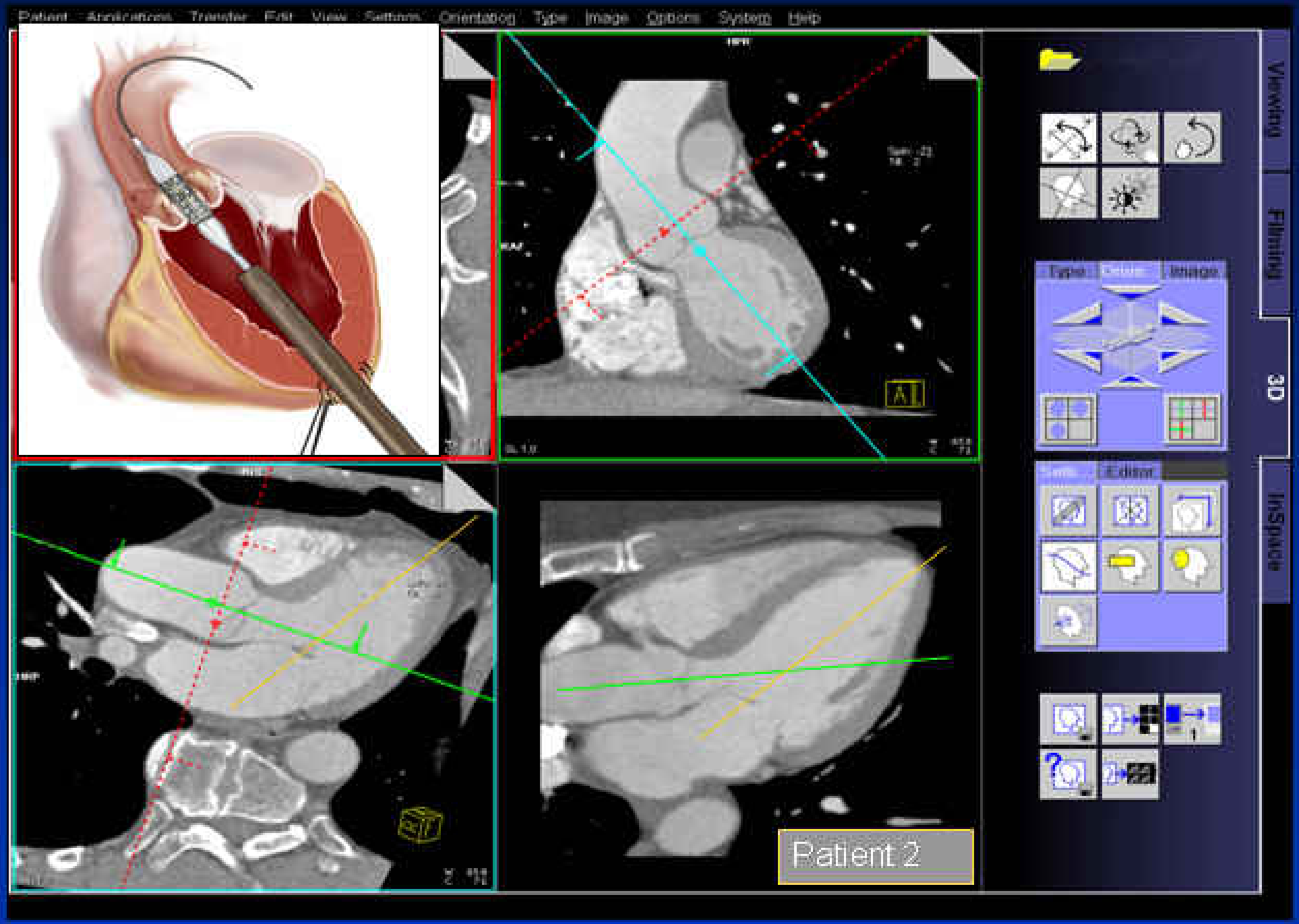
RAO 20 caudal 46



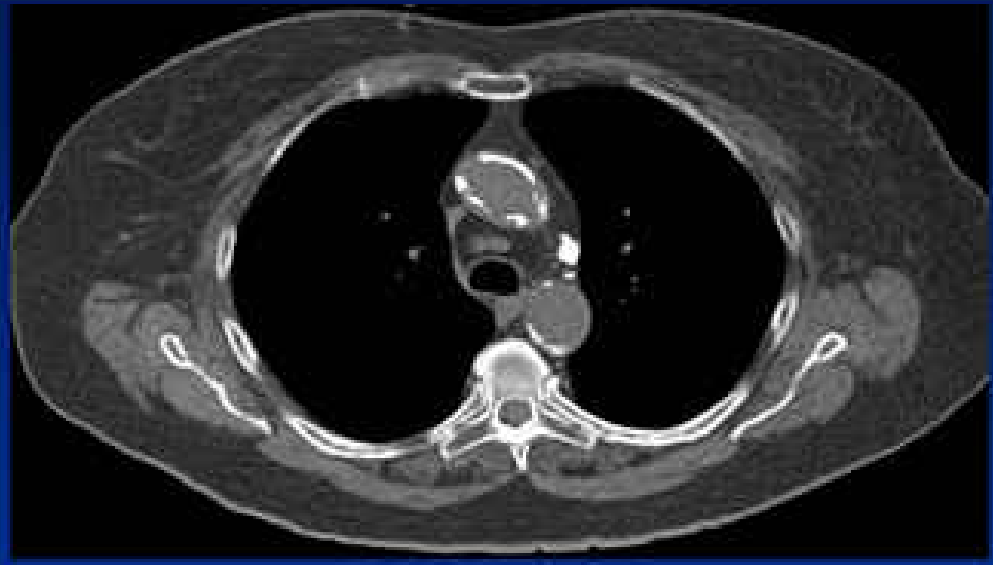


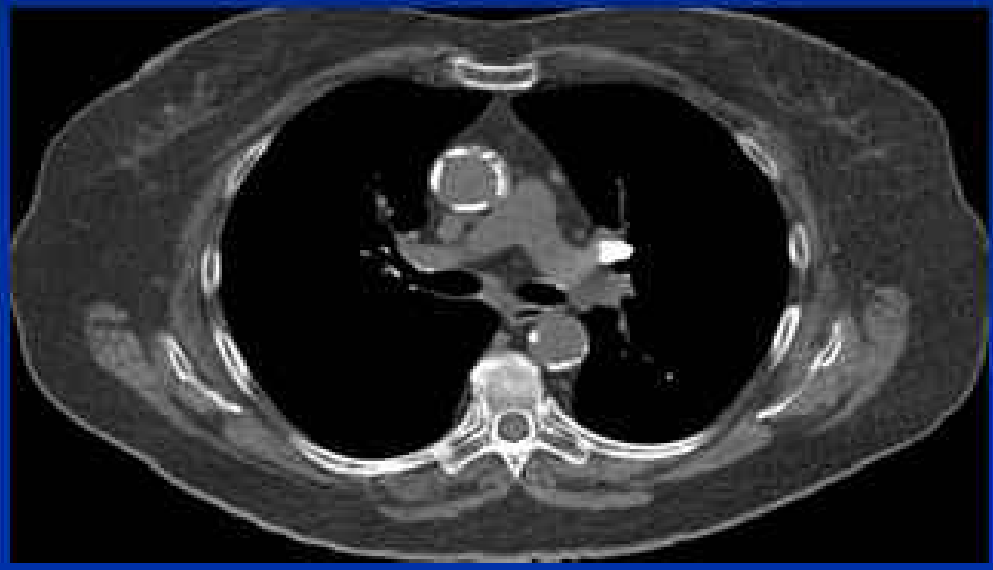
LAO 40 cranial 14



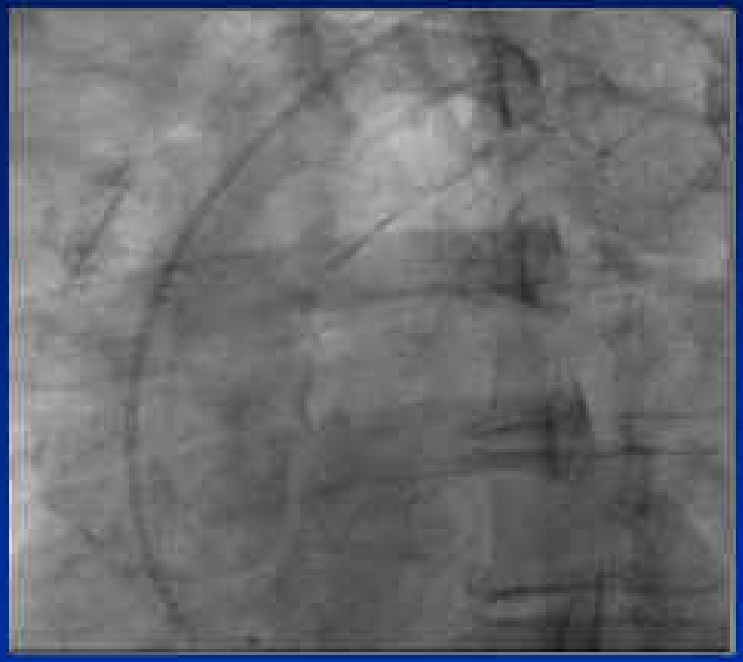

Patient
Application
Transfer
Edit
View
Settings
Orientation
Type
Image
Options
System
Help
Viewing
Filtering
3D
Inspace
Patient 2

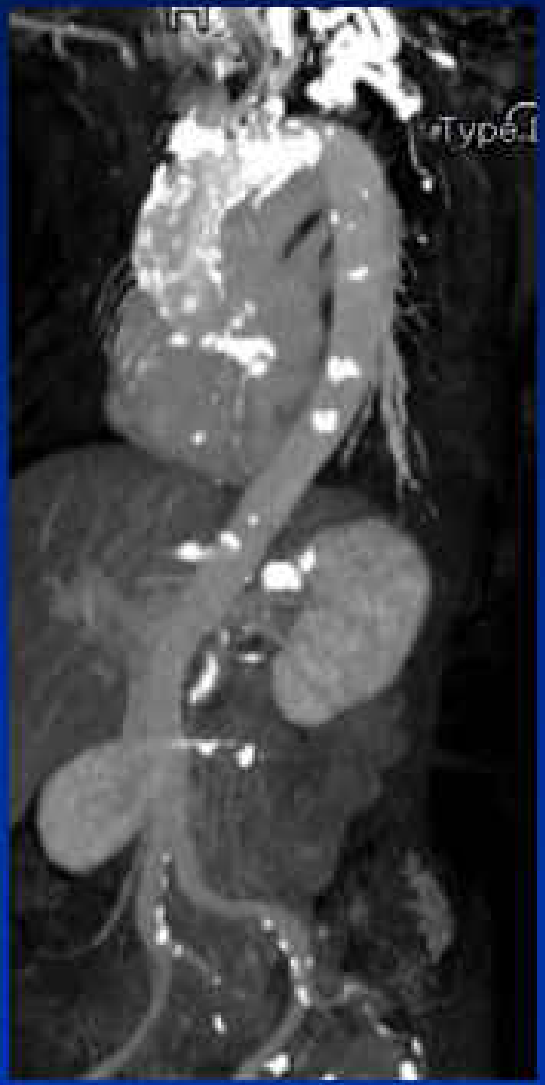
Arch Evaluation: Selection of Patients

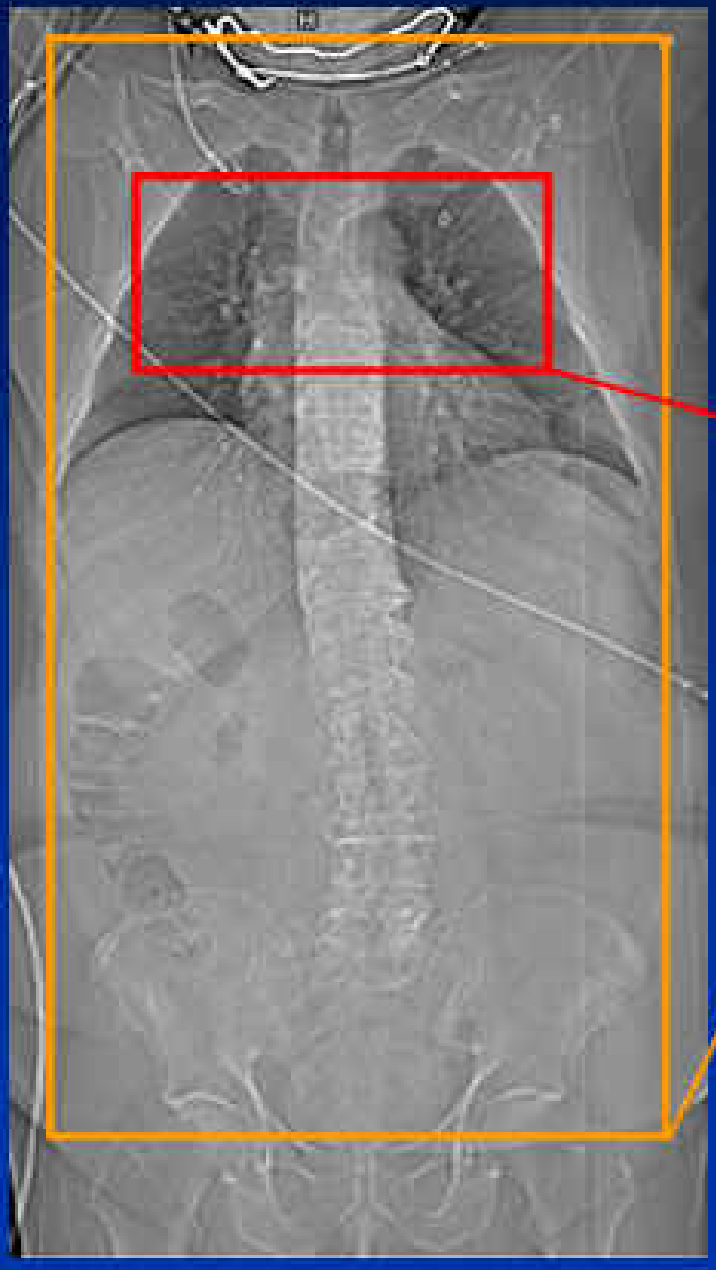


“Porcelain” Aorta





CT SCAN PROTOCOL



Dual Source Scanner

(Siemens Definition)

temporal resolution = 83 ms

or 64-slice scanner = 165 ms

Mode = spiral, gated (synchronized to heart beat)

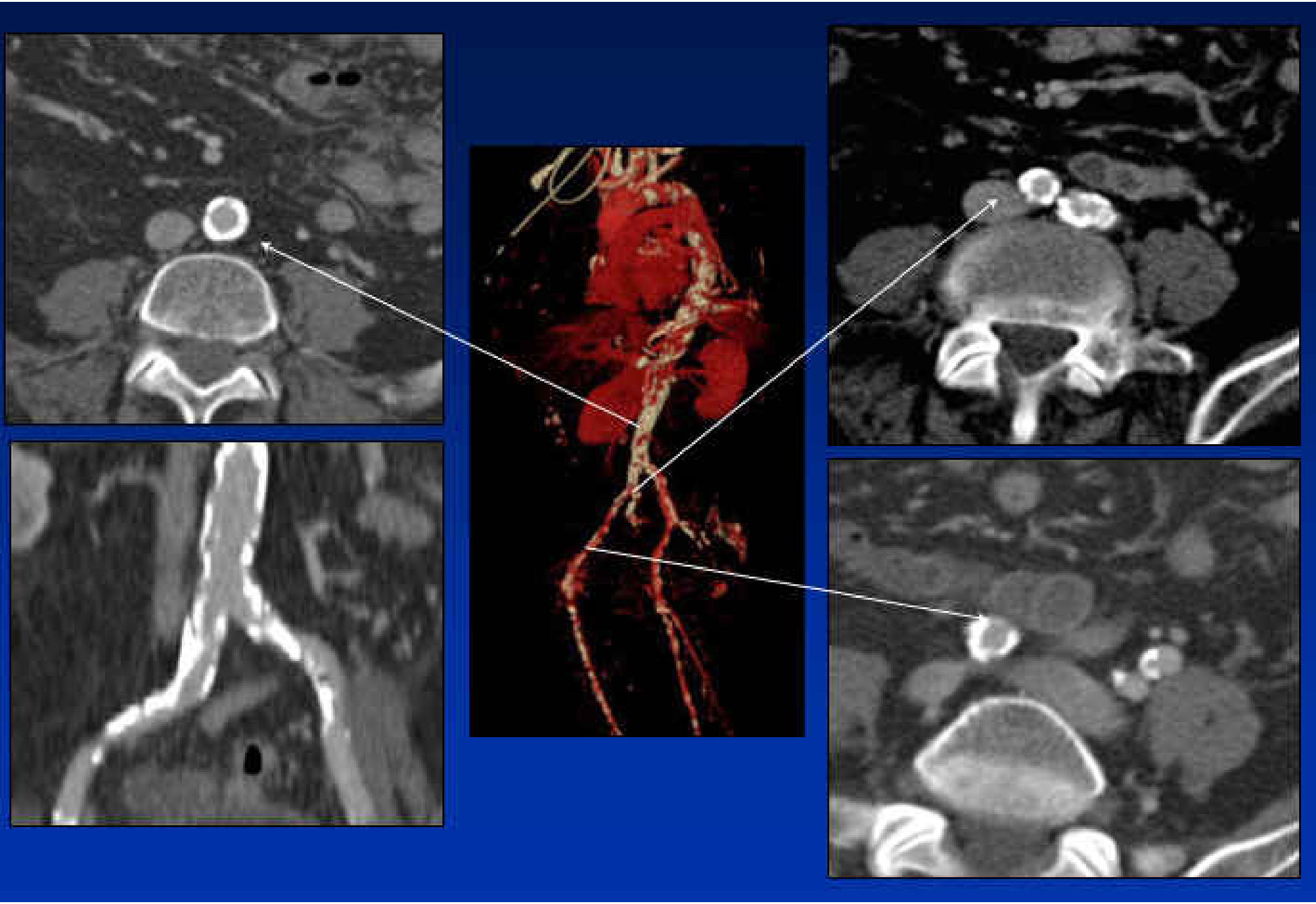
minimal slice thickness = 0.75 mm

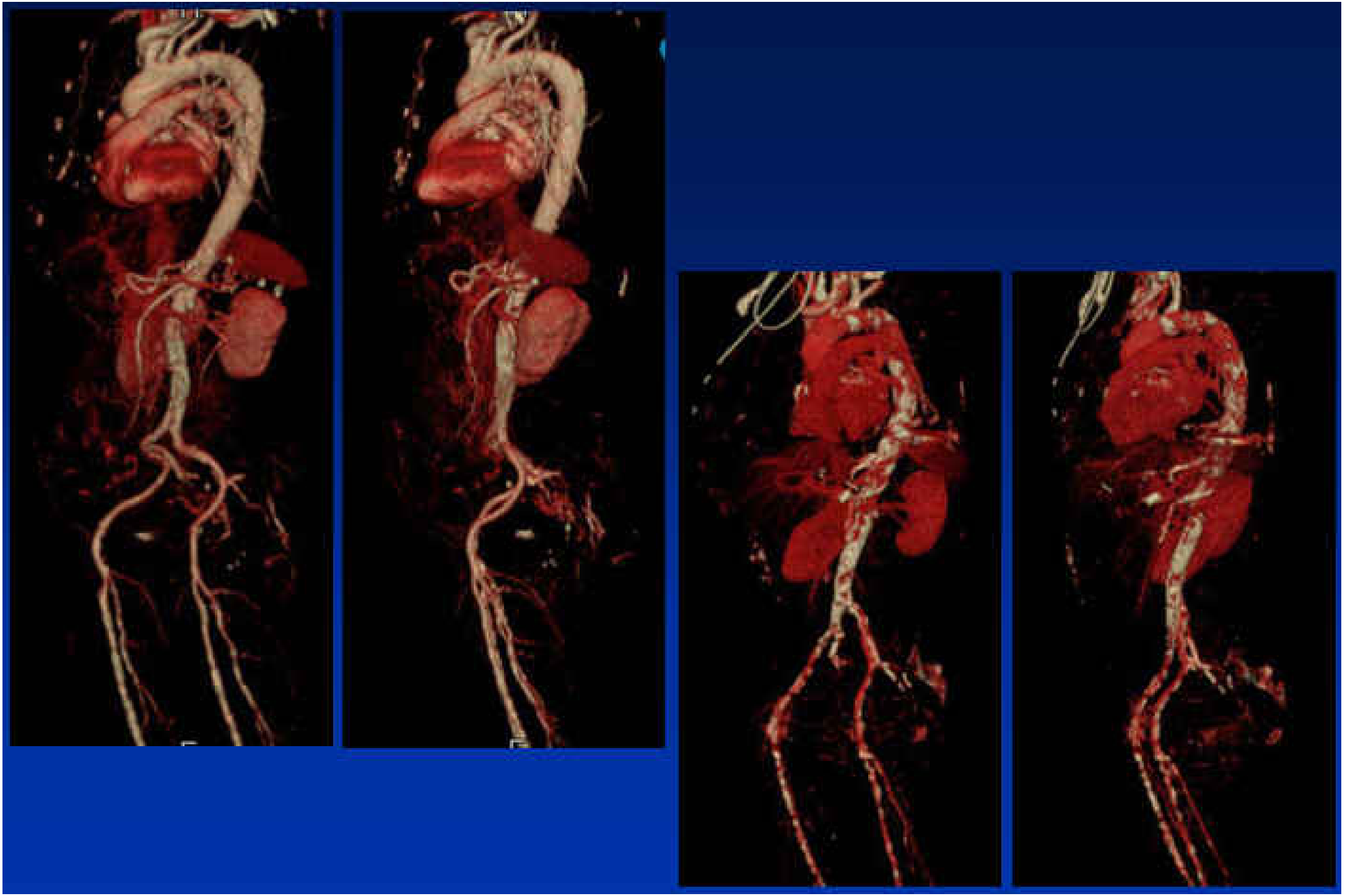
Mode = spiral, non-gated

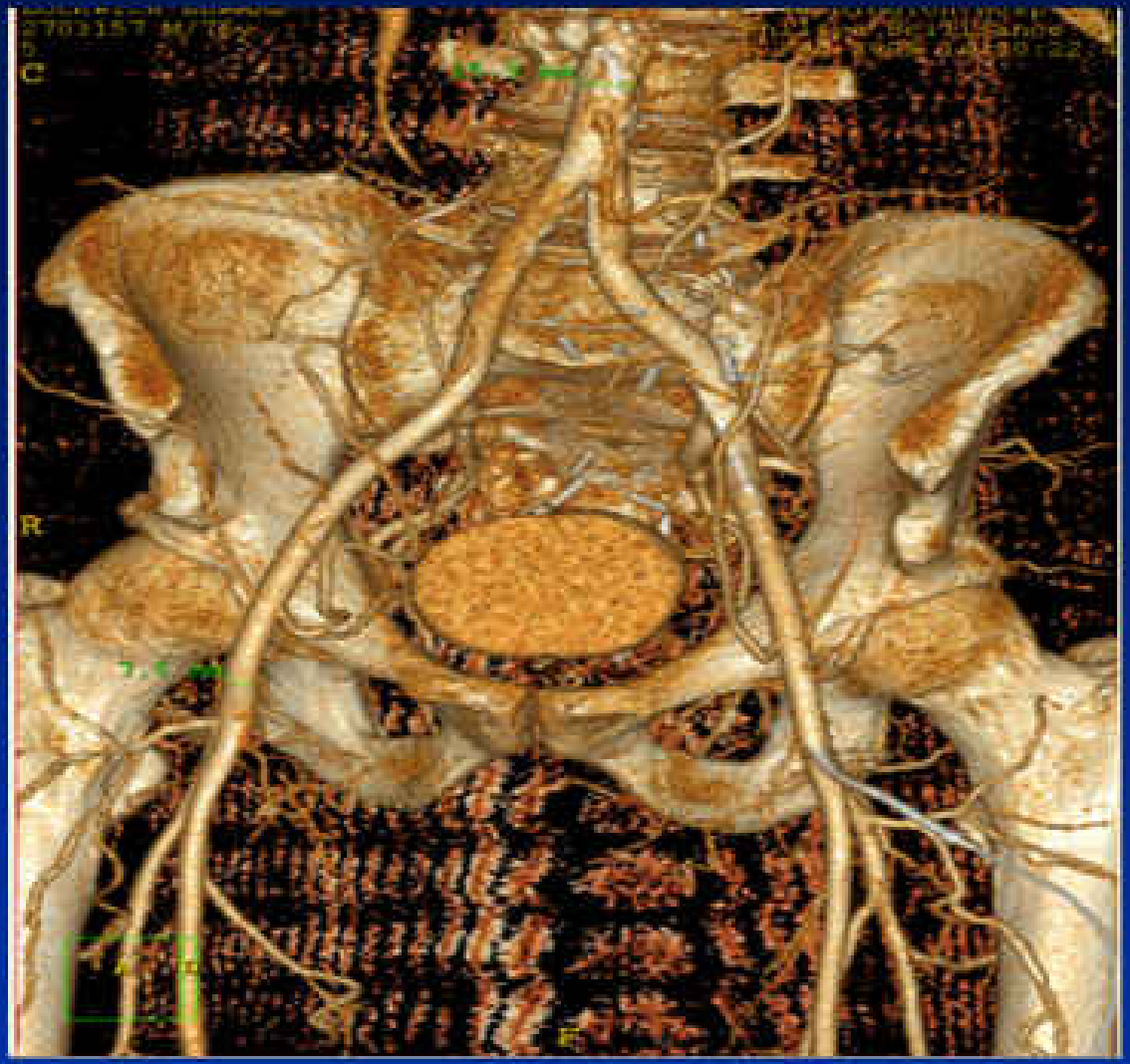
slice thickness = 3 mm

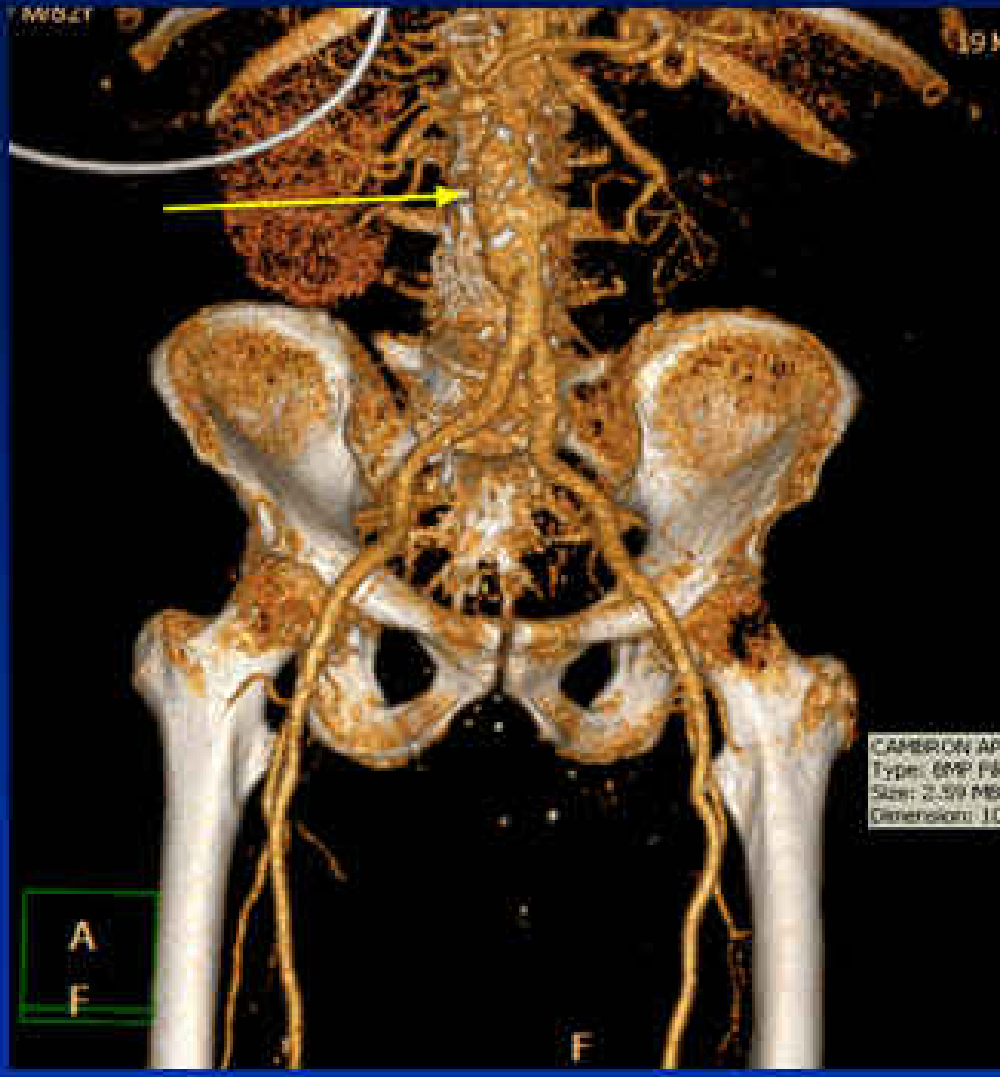
Inclusion criteria: stable sinus rhythm

80-150 ml iodinated contrast-material









- 4F pigtail in abdominal aorta
- Mix 20cc contrast + 60 cc saline
- Inject at 4 cc/sec for 10 seconds (13 cc of contrast).\

100 cc IV Contrast

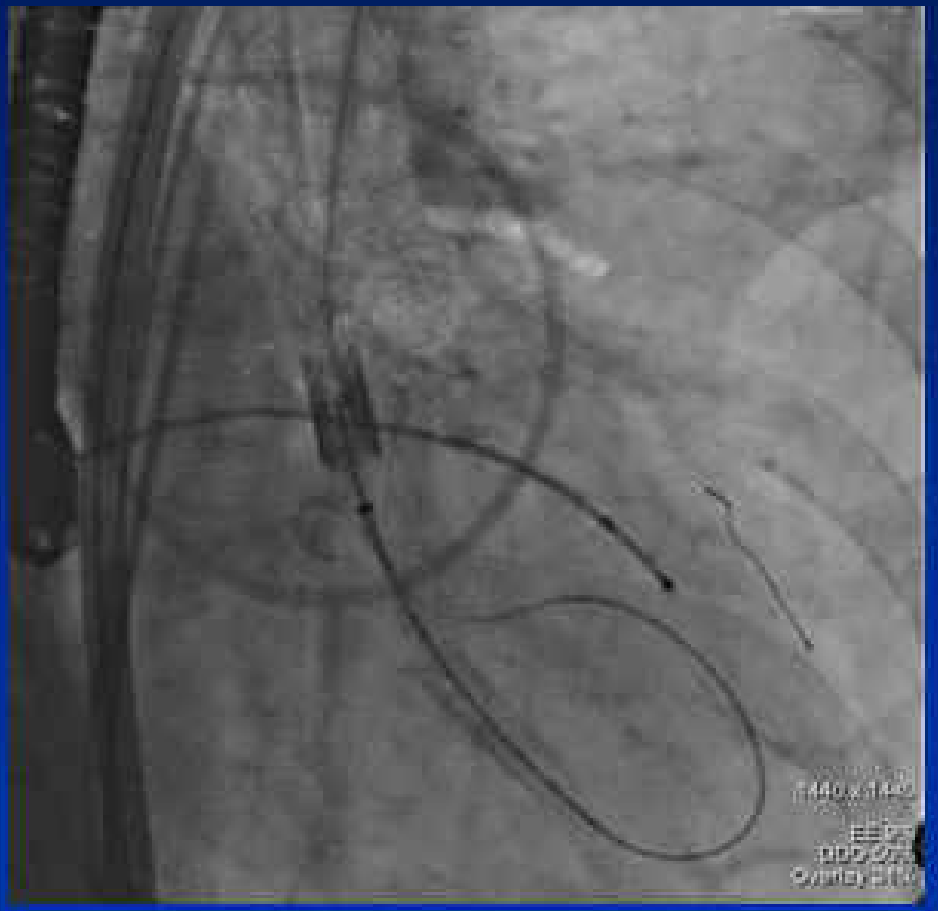
Courtesy of Dr. Richard, WHC

Iliac Anatomy by MDCT

Vessel	All AS patients (n=85)	Suitable patients (n=56)	Unsuitable patients (n=29)	p - value
Right Common Iliac Artery (mm)	10.6 ± 1.7	11.3 ± 1.7	9.4 ± 1.9	0.01
Right External Iliac Artery (mm)	8.8 ± 1.2	9.1 ± 0.9	7.1 ± 1.2	0.03
Right Common Femoral Artery (mm)	8.9 ± 1.1	9.2 ± 0.9	7.3 ± 1.3	0.04
Left Common Iliac Artery (mm)	10.4 ± 1.8	10.9 ± 1.6	9.3 ± 1.8	0.09
Left External Iliac Artery (mm)	8.6 ± 1.3	8.9 ± 1.1	7.3 ± 1.1	0.02
Left Common Femoral Artery (mm)	8.8 ± 1.3	9.2 ± 0.9	7.5 ± 1.2	0.09

Kurra V, et al. Presence of Significant PAD in Patients Assessed for Percutaneous Aortic Valve Replacement. Implications for Feasibility of Transfemoral Approach.

Percutaneous AVR: DynaCT




Imaging is the key to success