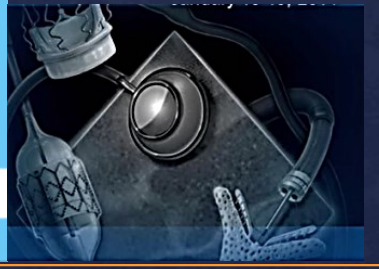
2019

7ème SÉMINAIRE de CARDIOLOGIE INTERVENTIONNELLE de TROYES

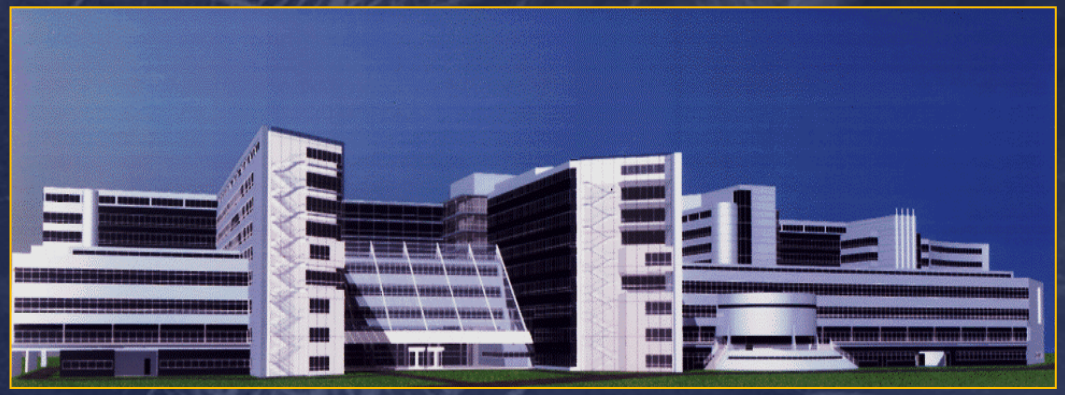
16 & 17 MARS

HÔTEL MERCURE TROYES CENTRE
11, Rue des Bas Trevois 10004 Troyes - France



Le prolapsus mitral: apports de l' échographie 2D/3D

A.Berrebi



HEGP – Paris V

Institut Mutualiste Montsouris

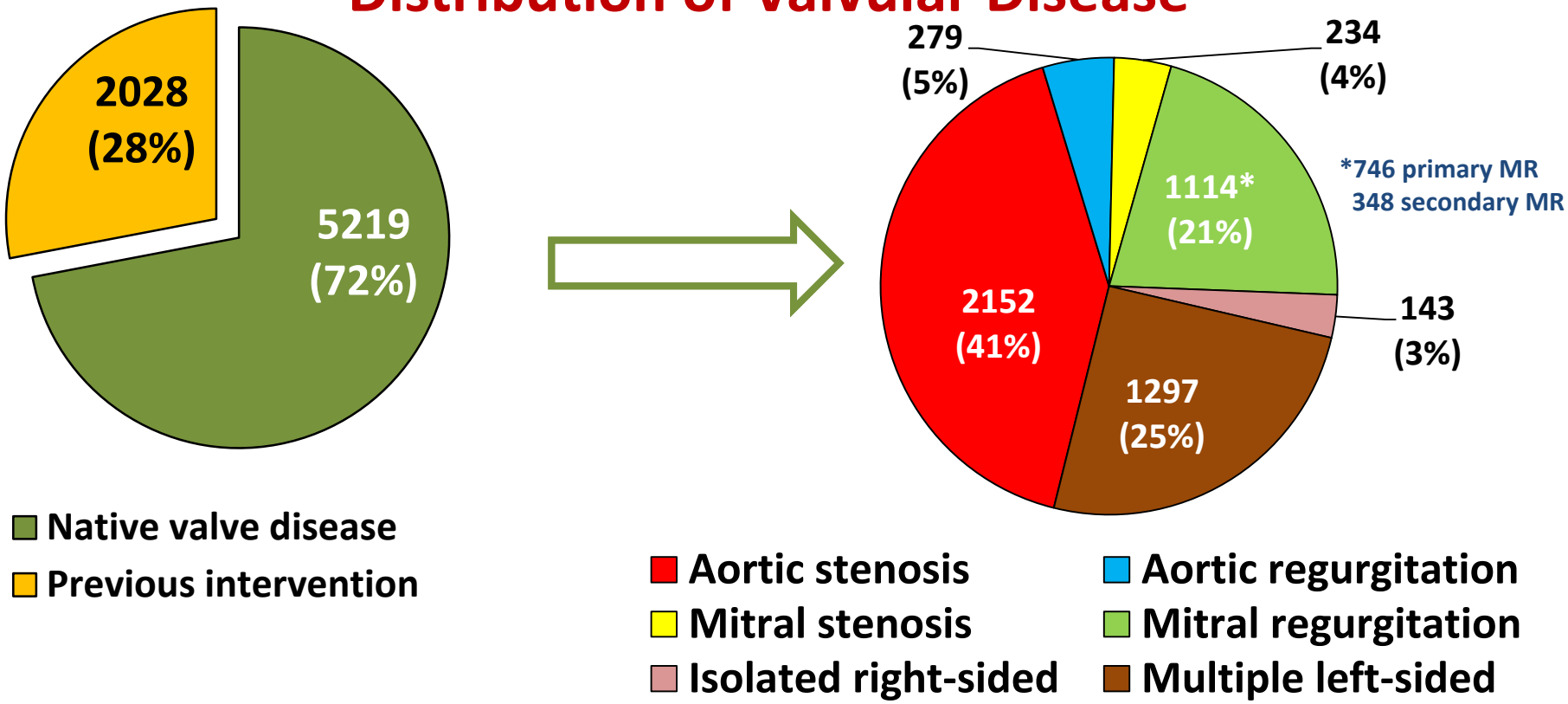
Disclosure

Speaker's bureau:

- ✓Edwards Lifesciences
- ✓Philips Healthcare

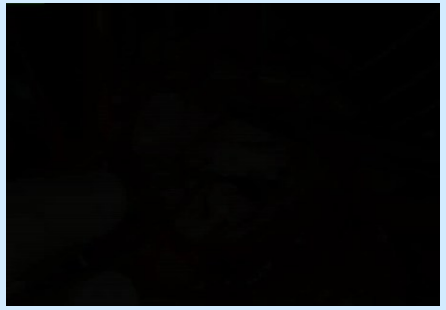
EORP VHD II registry

Distribution of Valvular Disease

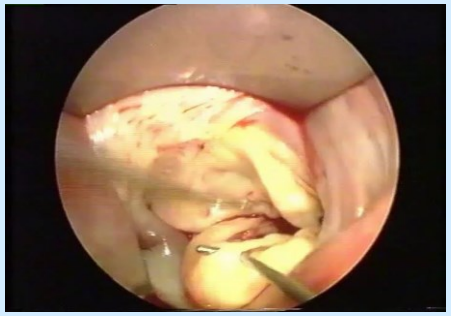


Options in MR Interventions

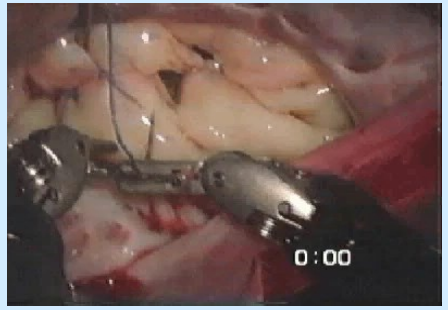
Open



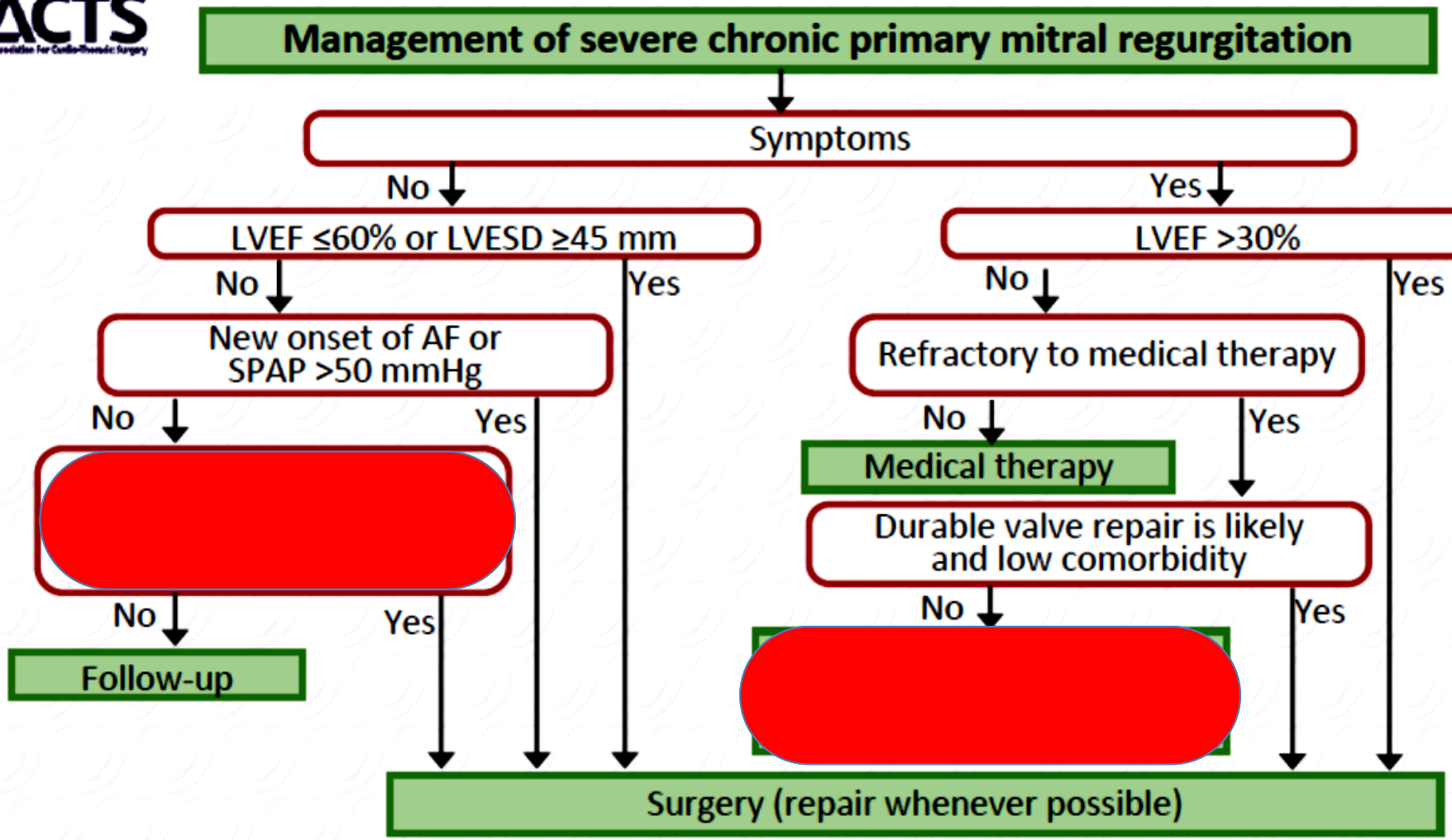
Video assisted



Robotic



Percutaneous

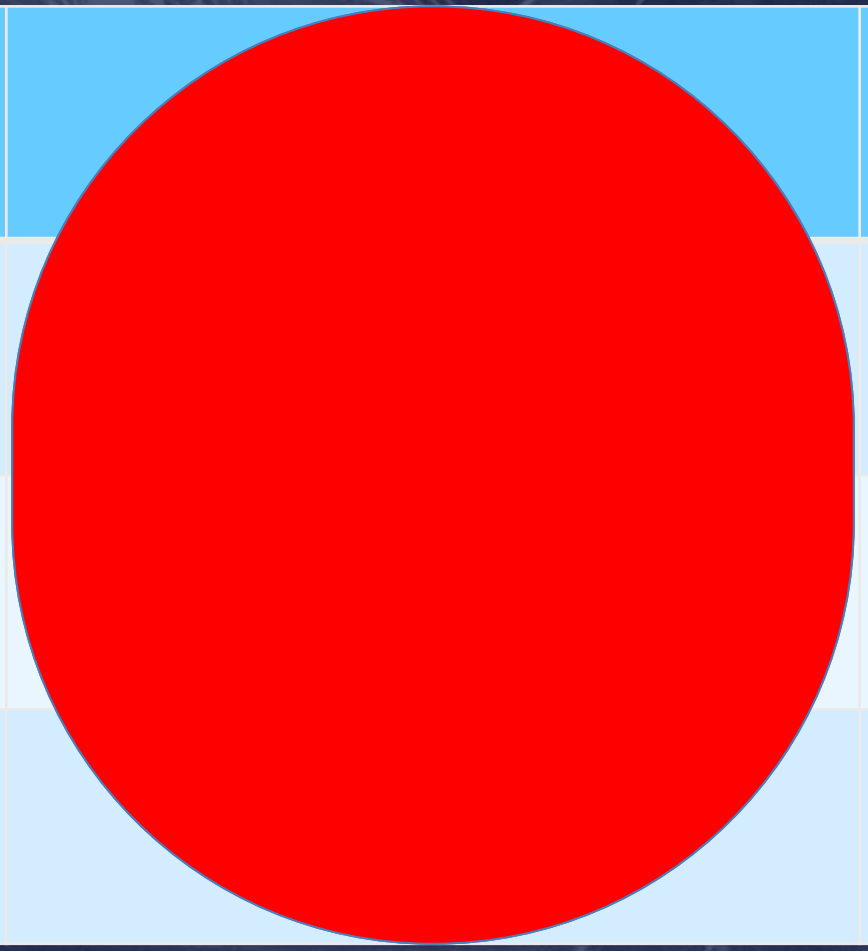


[a] *LVESD ≥40 mm and one of the following present: flail leaflet or LA volume ≥60 mL/m² BSA at sinus rhythm*

Eur Heart J. 2017;38:2739–91

Interventional 2D/3D echocardiography

		Transcatheter-Rx
Valve Analysis		+++
Positioning		+++
Control		+++



Volume 86, Number 3 September 1983

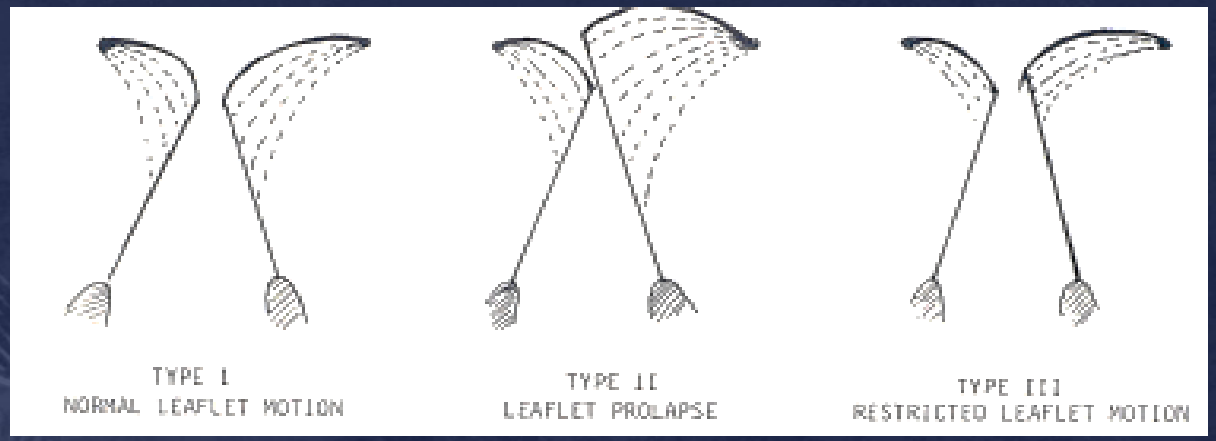
The Journal of THORACIC AND CARDIOVASCULAR SURGERY

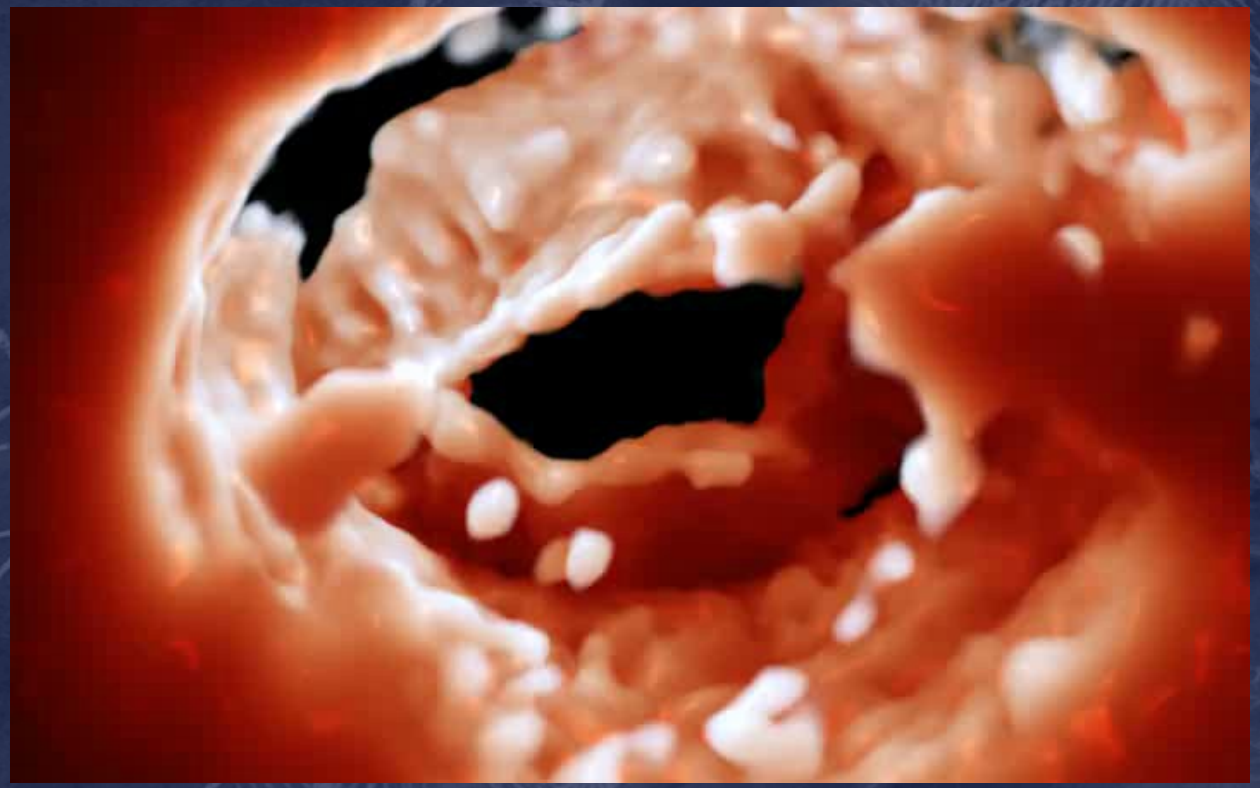
J THORAC CARDIOVASC SURG 86:323-337, 1983

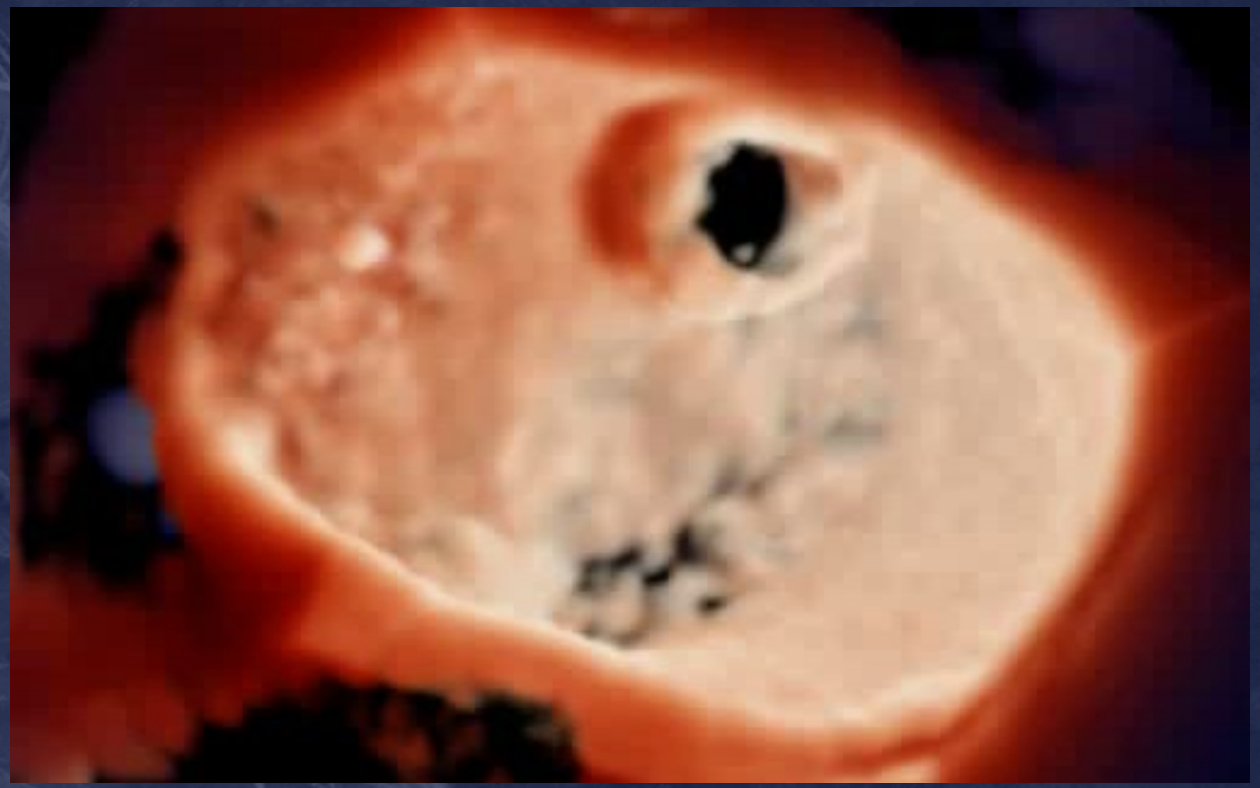
Honored Guest's Address

Cardiac valve surgery—the "French correction"

Alain Carpentier, M.D., *Paris, France*

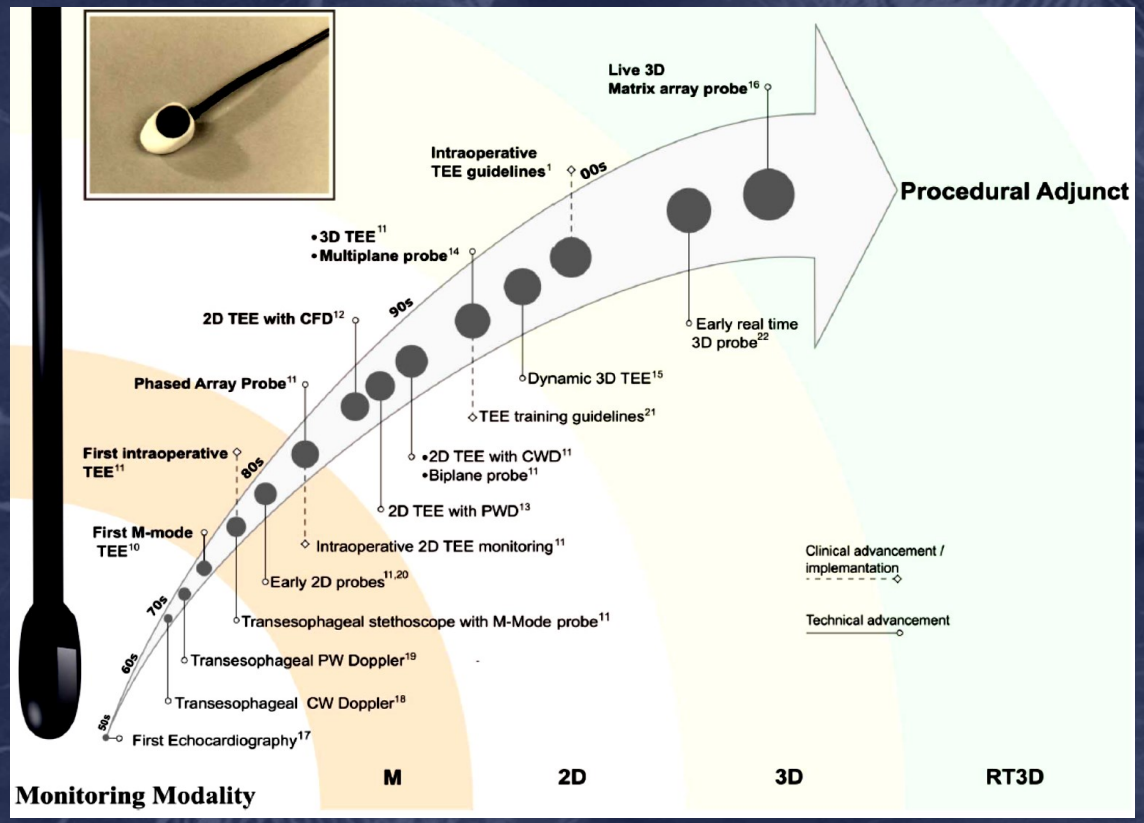






Perioperative transoesophageal echocardiography: current status and future directions

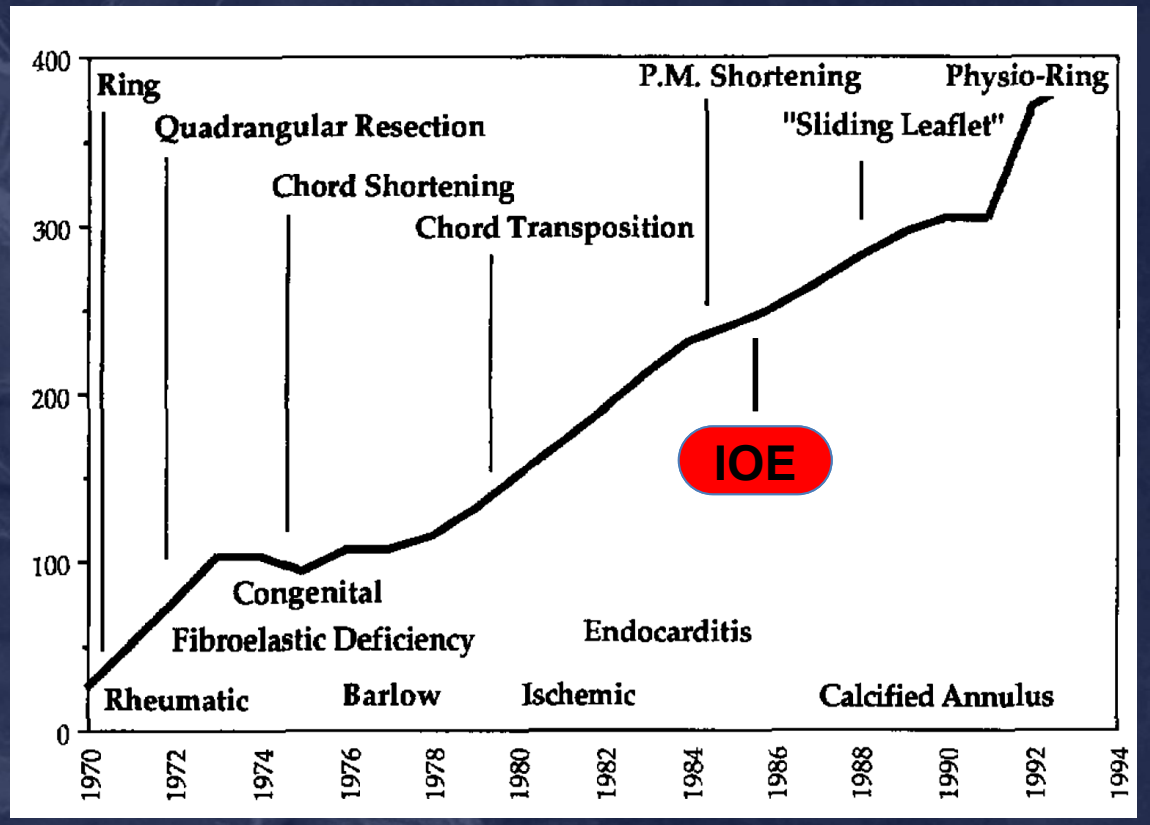
Feroze Mahmood,[1] Stanton Keith Shernan[2]



Heart. 2016;102(15):1159-67

The "Physio-Ring": An Advanced Concept in Mitral Valve Annuloplasty

Alain F. Carpentier, MD, PhD, Arrigo Lessana, MD, John Y. M. Relland, MD, Emre Belli, MD, Serban Mihaileanu, MD, Alain J. Berrebi, MD, Evelyn Palsky, MD, and Didier F. Loulmet, MD



Ann Thorac Surg 1995;60:1177-86

Team effort

IOE and Valve Reconstruction

- ✓ Pre-pump: a road map
- ✓ Post pump: a safety net
- ✓ Barlow: new approach

IOE and Valve Reconstruction

- ✓ Pre-pump: a road map
- ✓ Post pump: a safety net
- ✓ Barlow: new approach

Not to predict « feasibility »

- ✓ Valve analysis by Echo
- ✓ Leaflet tissue: amount and quality (pliability & *fragility*)
- ✓ Surgeon’s expertise +++

Valve Analysis: a common terminology

Myxomatous Disease, Flail Leaflet, Partial-Flail, Mitral Valve Prolapse Syndrome, Billowing, Floppy valve …..

Pathophysiological Triad*

Etiology → The Cause of Valve Disease

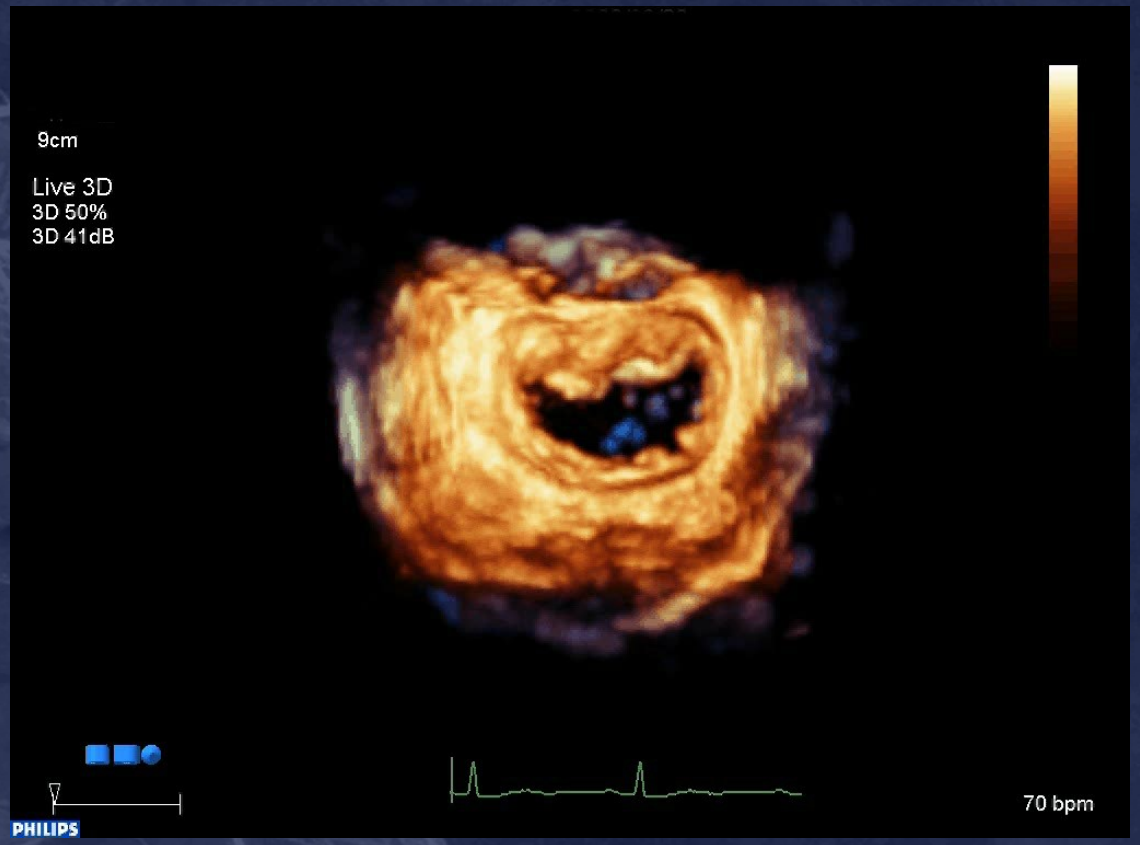
Lesions → The Result of the Disease Process

Dysfunction → The Result of the Lesions

**A.Carpentier:J Thorac Cardiovasc Surg 86 (3):323-37, 1983*

	Etiology	Lesion	Dysfunction
Echo	++	+	+++
Surgeon	++	+++	+

The Functional approach



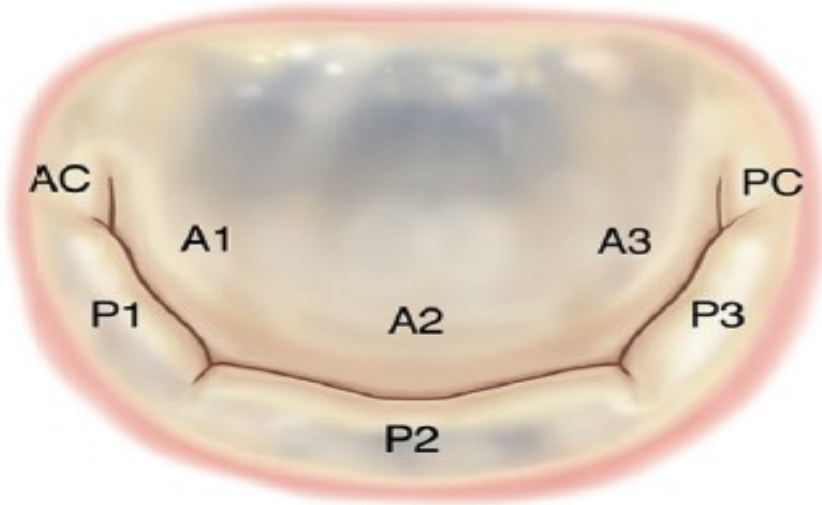
Goal of repair: to correct dysfunction

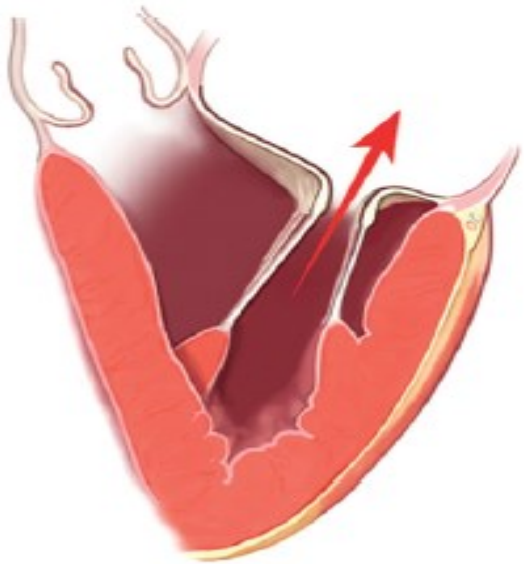
How to repair: one lesion-one technique

Echo assessment: Valve Analysis

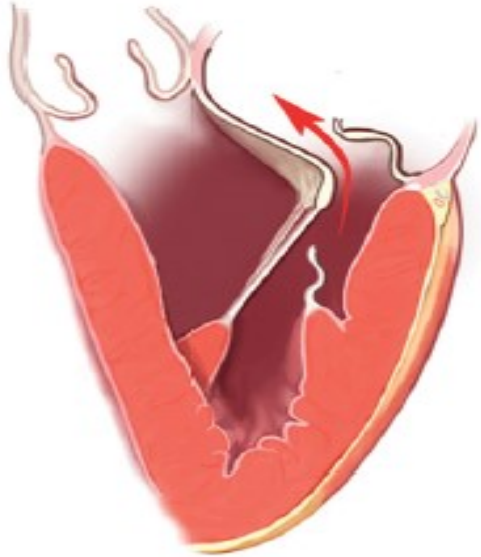
« foundations for performing valve reconstruction »

- ✓ Dysfunction
  - ✓ Functional classification
  - ✓ Segmental analysis
- ✓ Lesion
- ✓ Etiology
- ✓ Risk of SAM
- ✓ Tricuspid

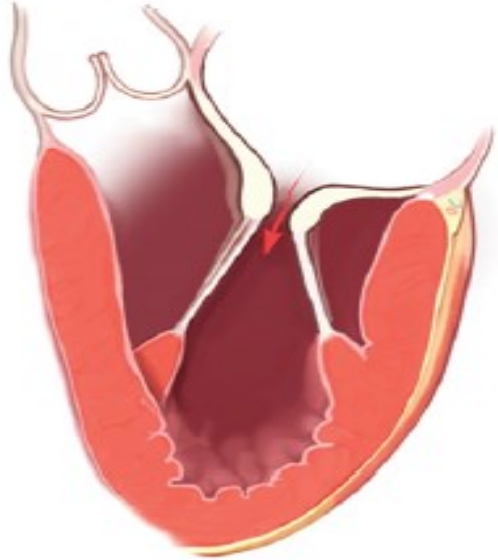




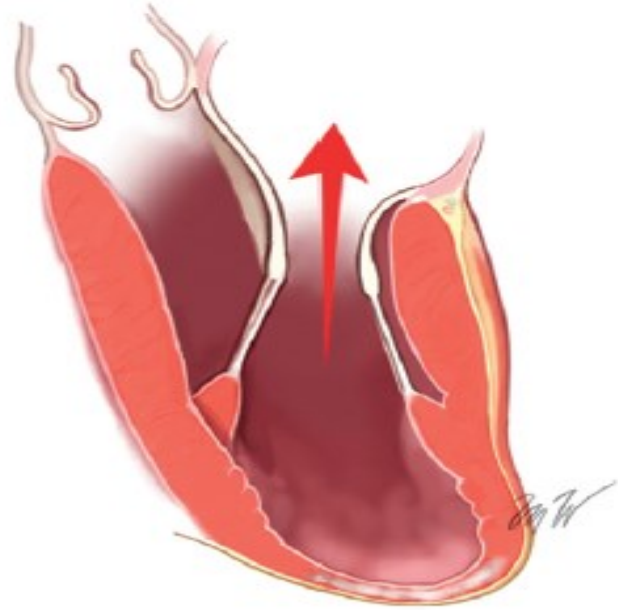
Type I
Normal leaflet motion



Type II
Increased leaflet motion



Type IIIa
Restricted leaflet motion
(systole and diastole)



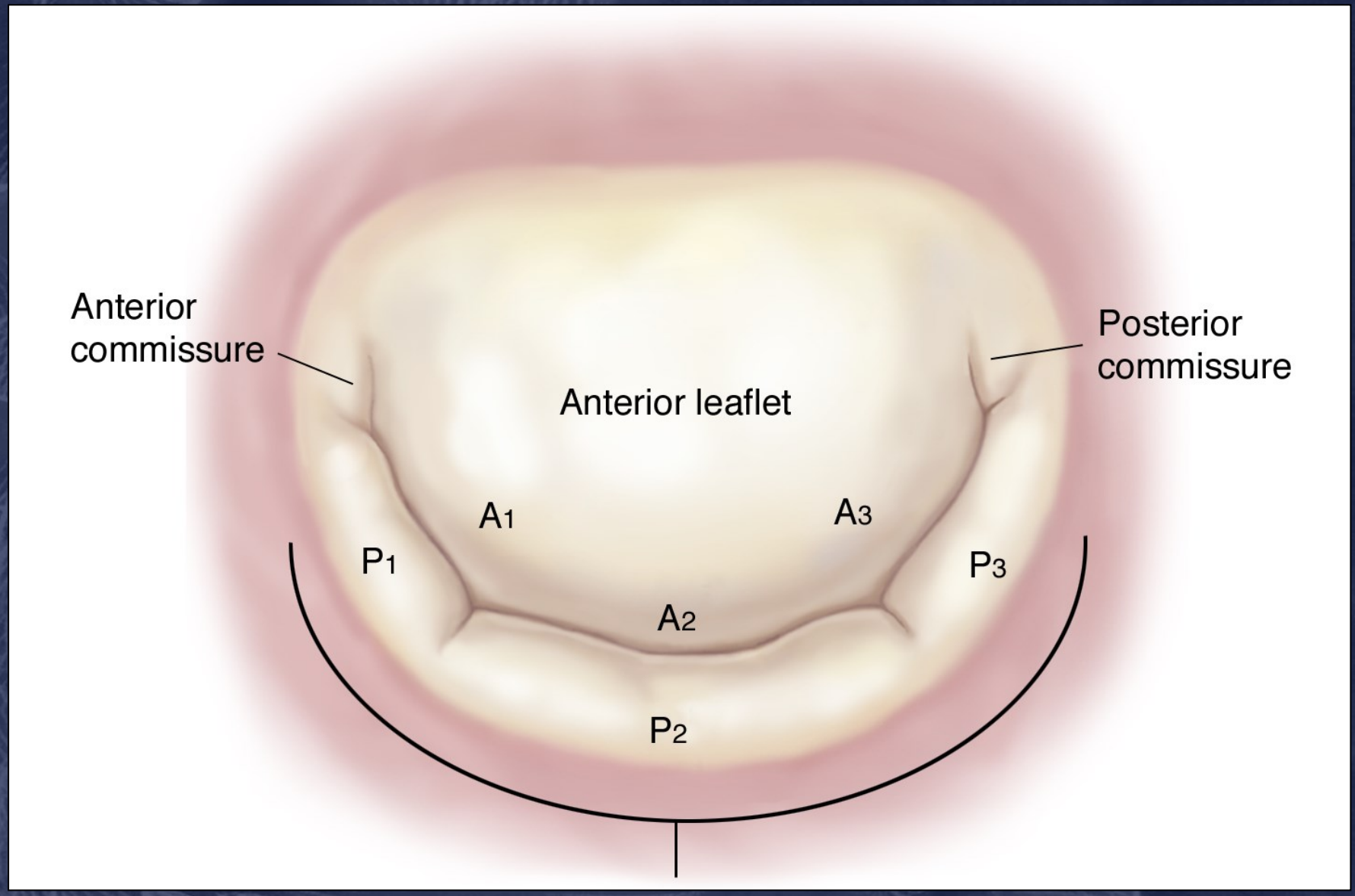
Type IIIb
Restricted leaflet motion
(systole)

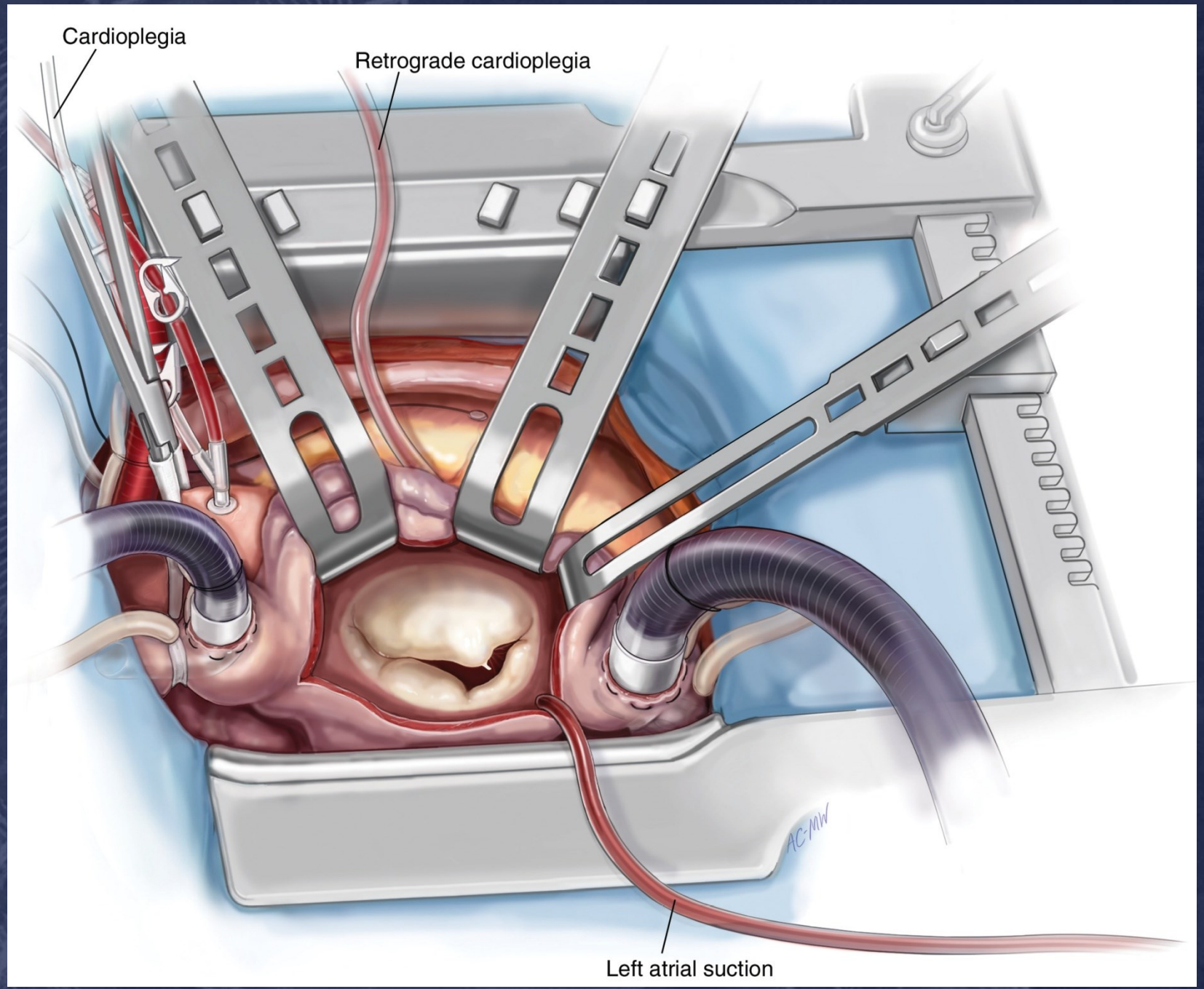
Carpentier's Classification

Type I	Type II	Type IIIa	Type IIIb
Normal leaflet motion	Increased leaflet motion	Restricted leaflet motion (systole and diastole)	Restricted leaflet motion (systole)

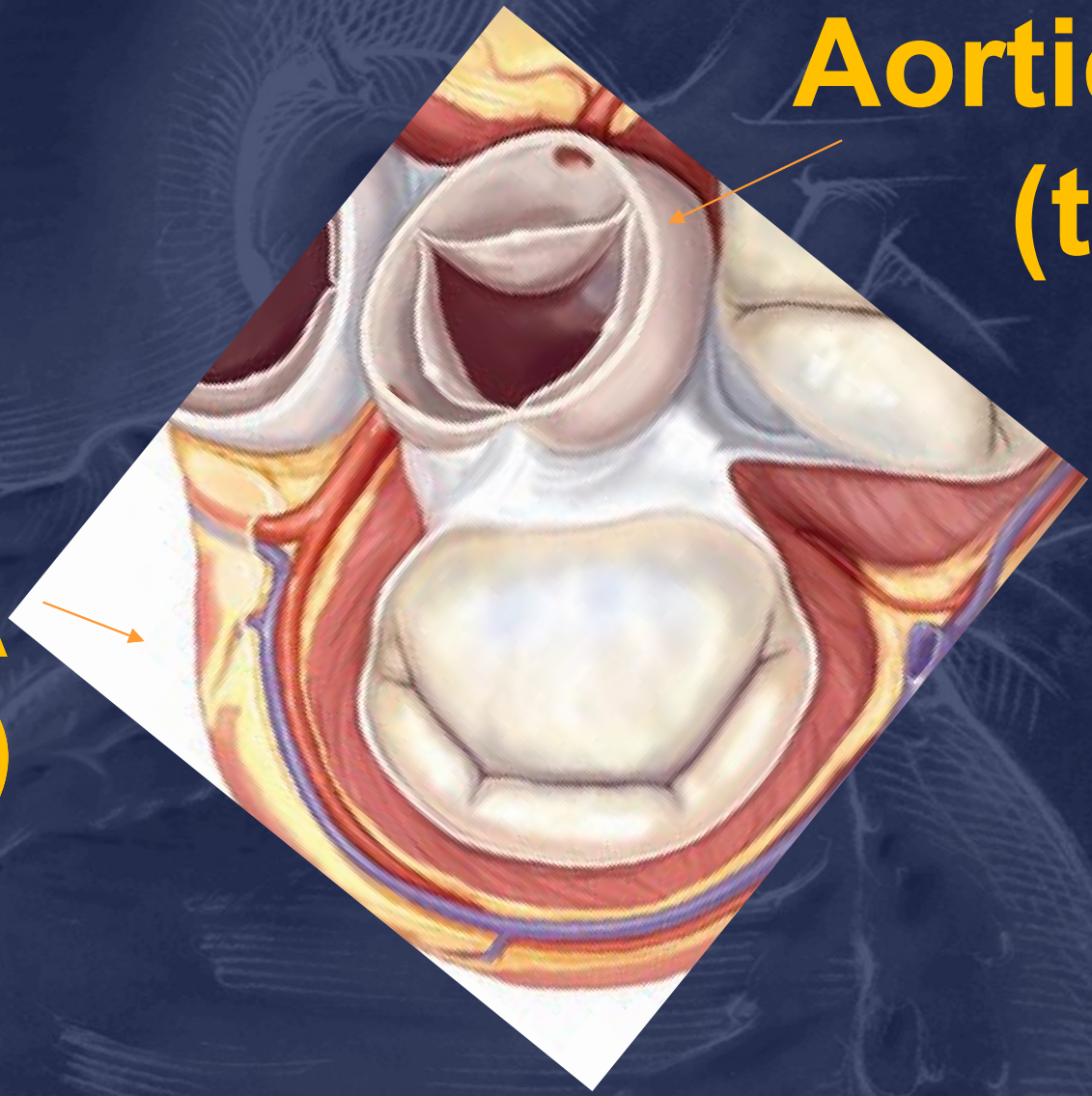
Based upon *2D Leaflet Motion*

Segmental Analysis



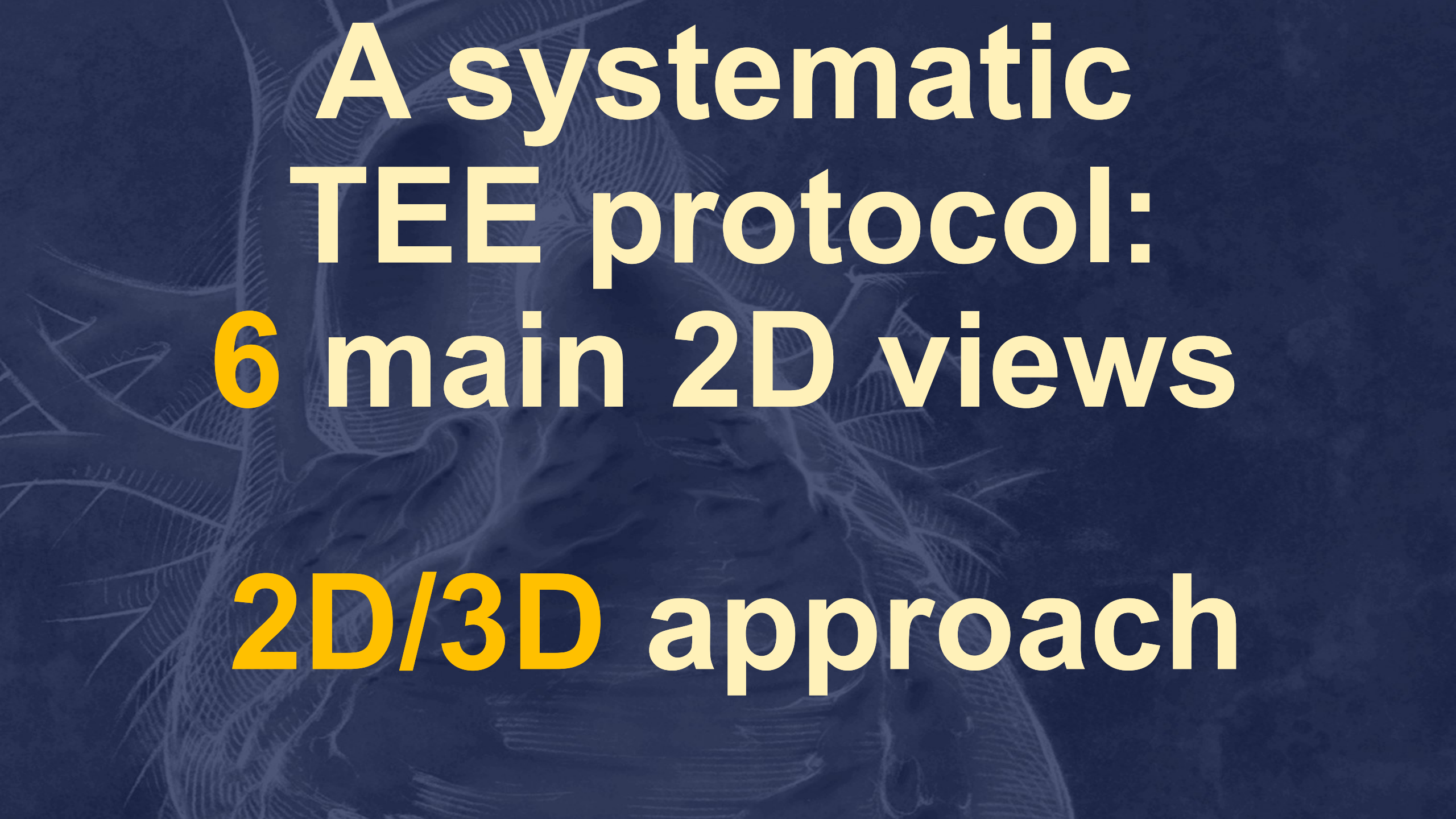

Cardioplegia
Retrograde cardioplegia
Left atrial suction

3D Surgical View: 2 landmarks



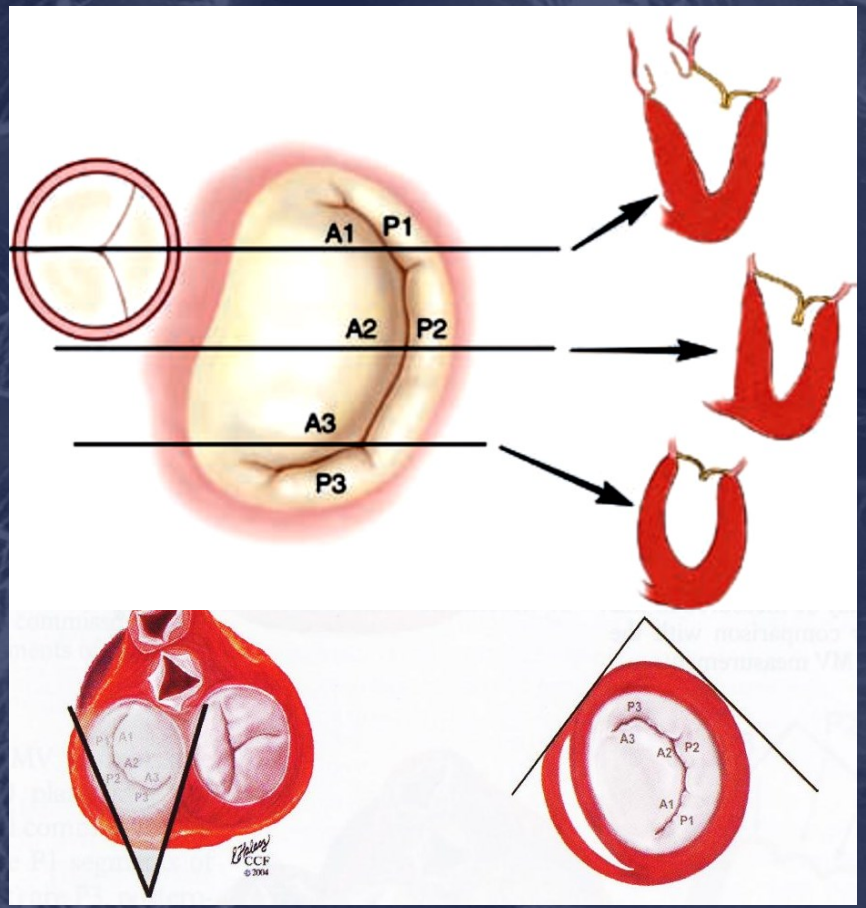
Aortic Valve (top)

LAA (left)

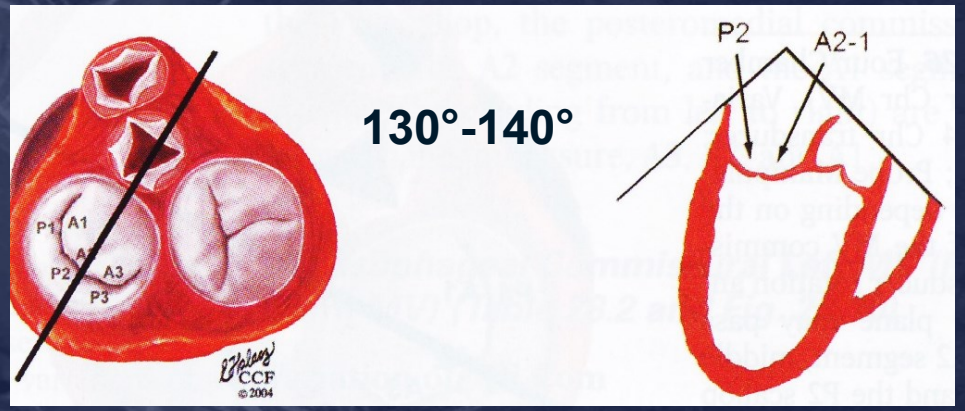

A systematic
TEE protocol:
6 main 2D views
2D/3D approach

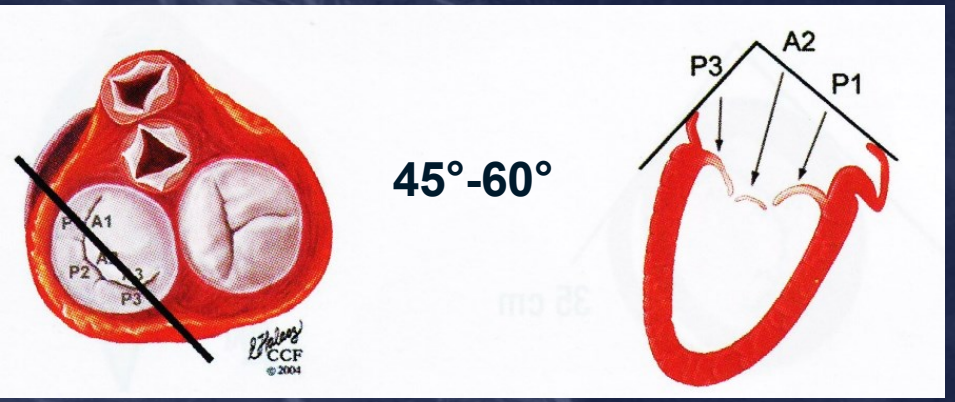
6 views

Monoplane 0°



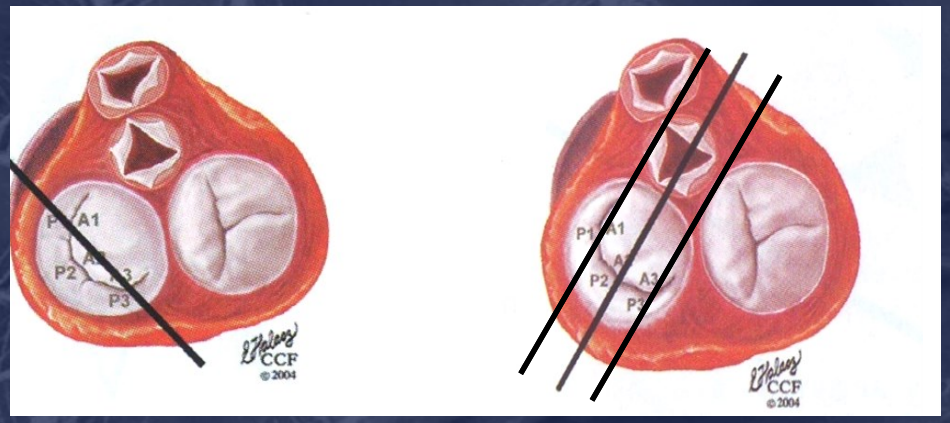
Multiplane

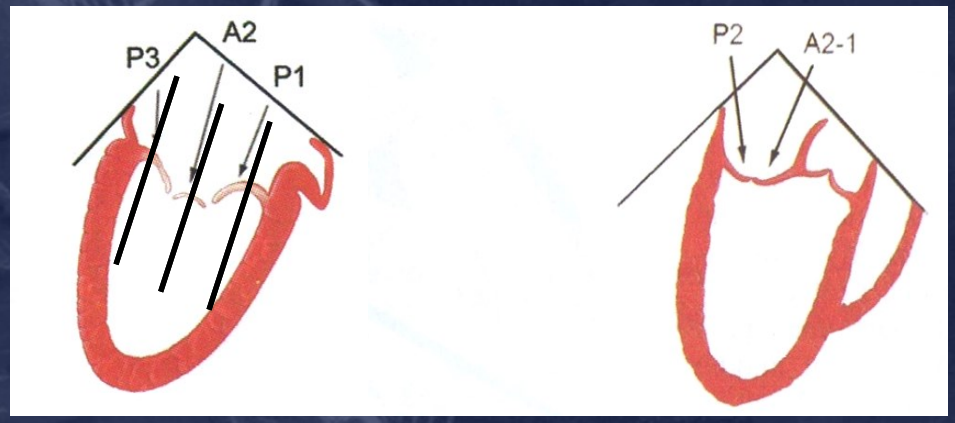




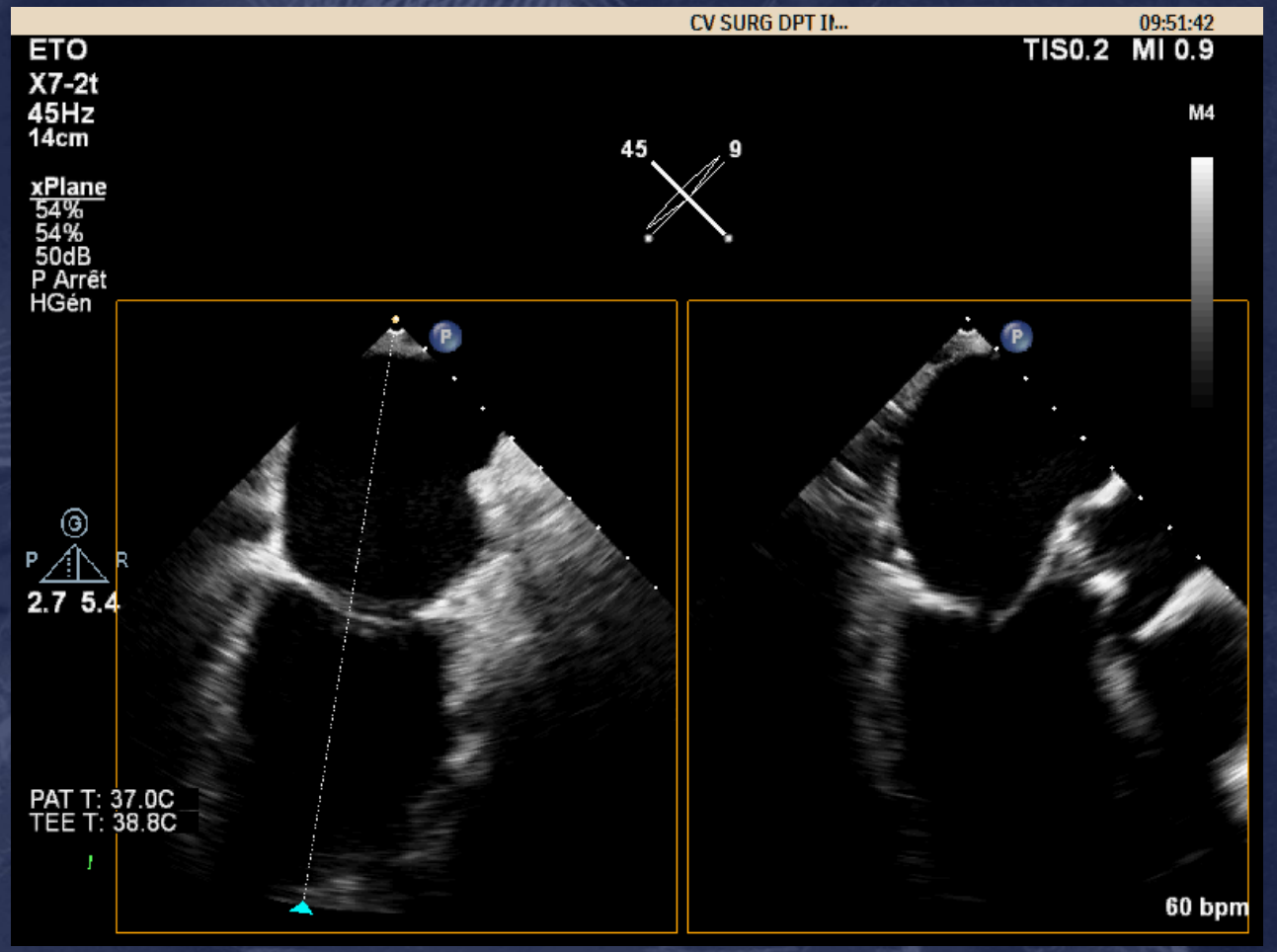
X Plane protocol: the must

45-60° +90° 135-150° Bicommissural-Long axis

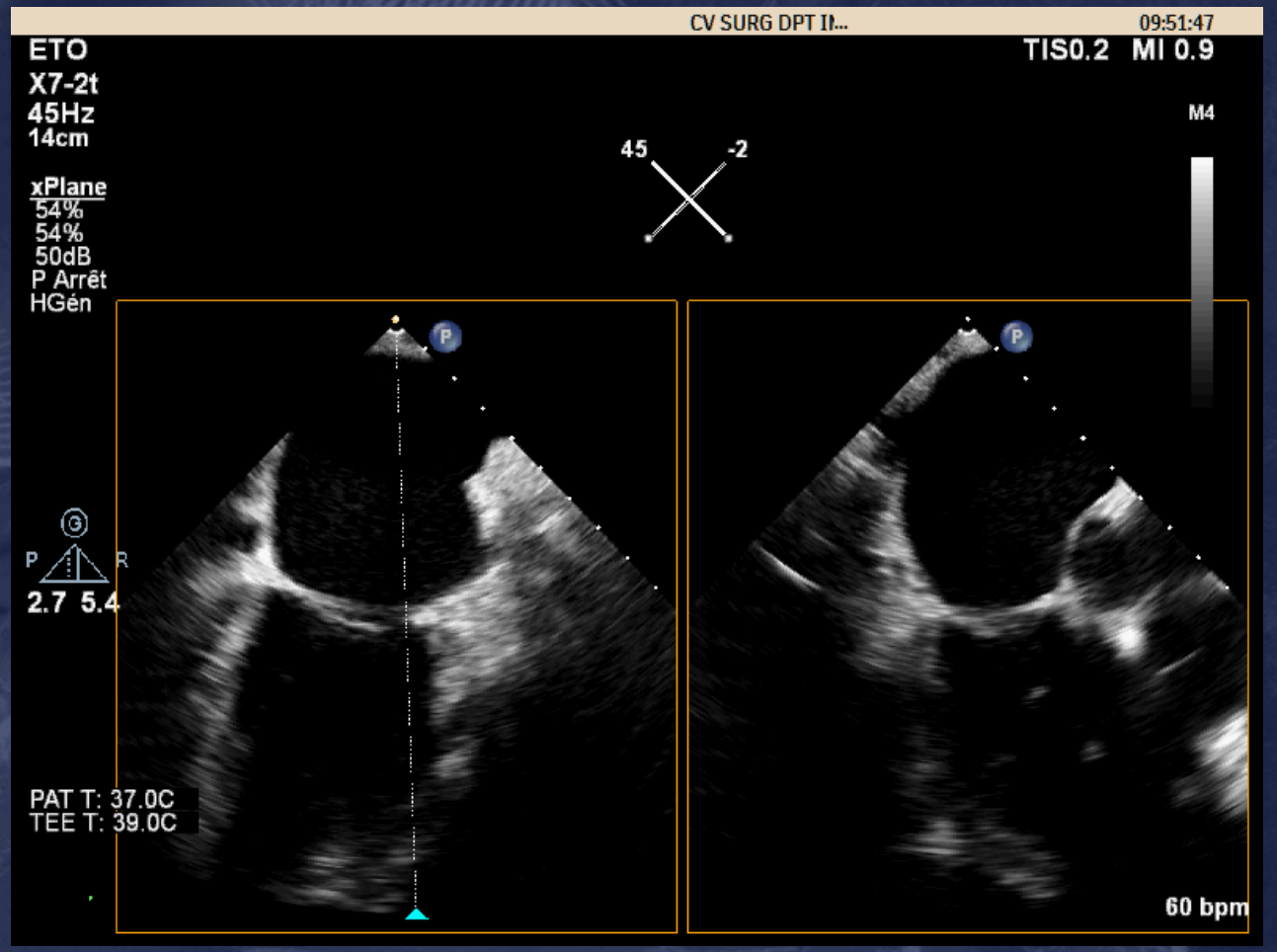




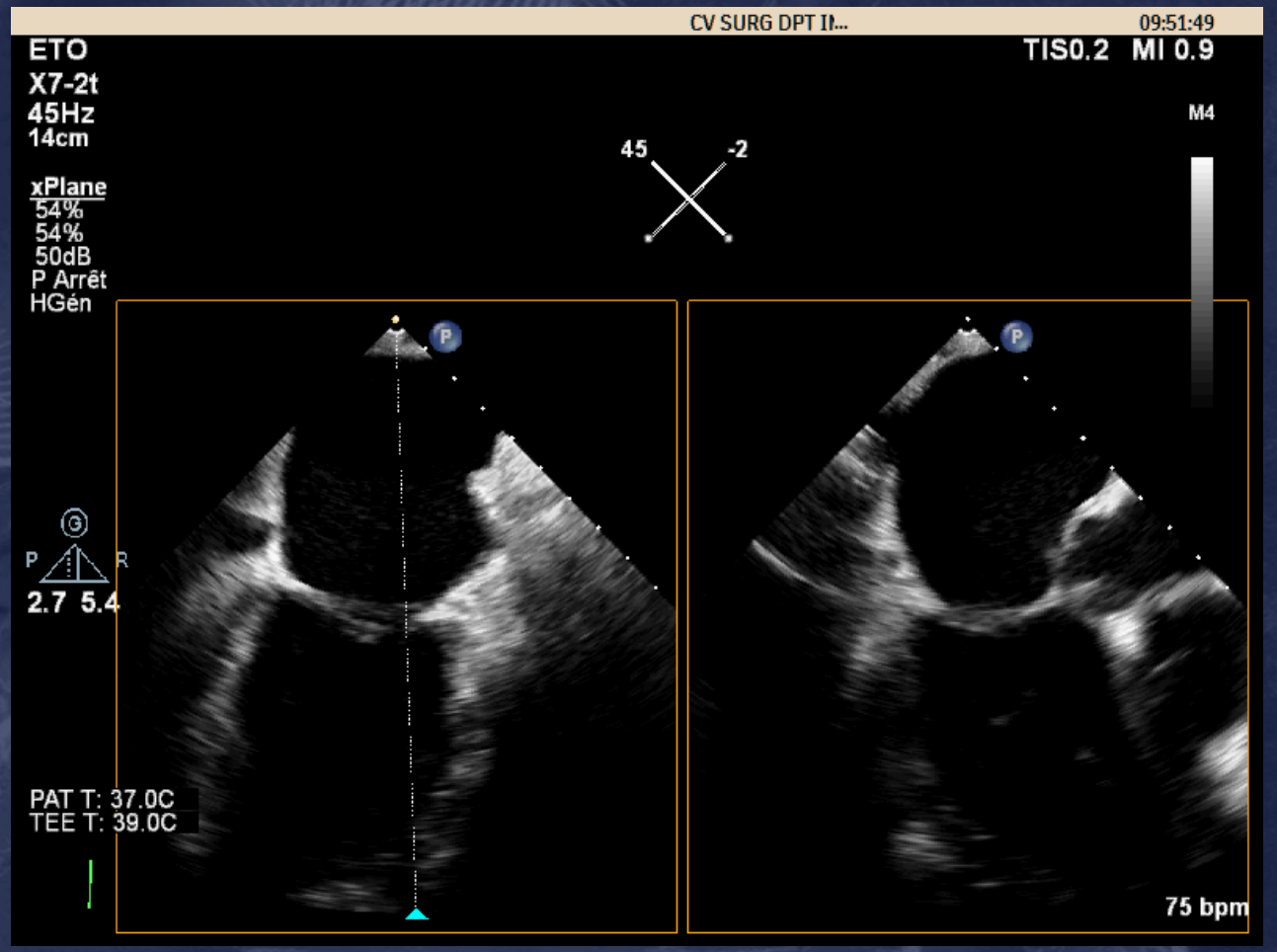
X Plane for Mitral Valve Analysis (A2P2)

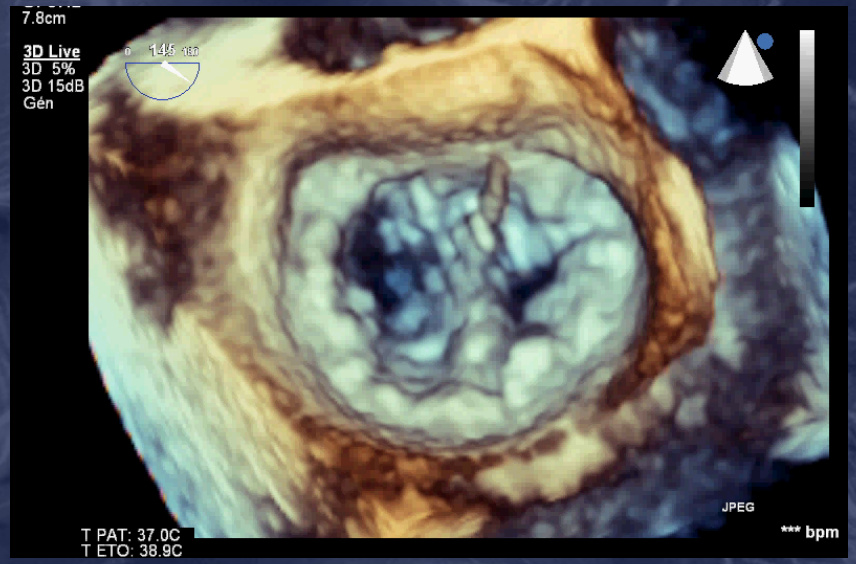


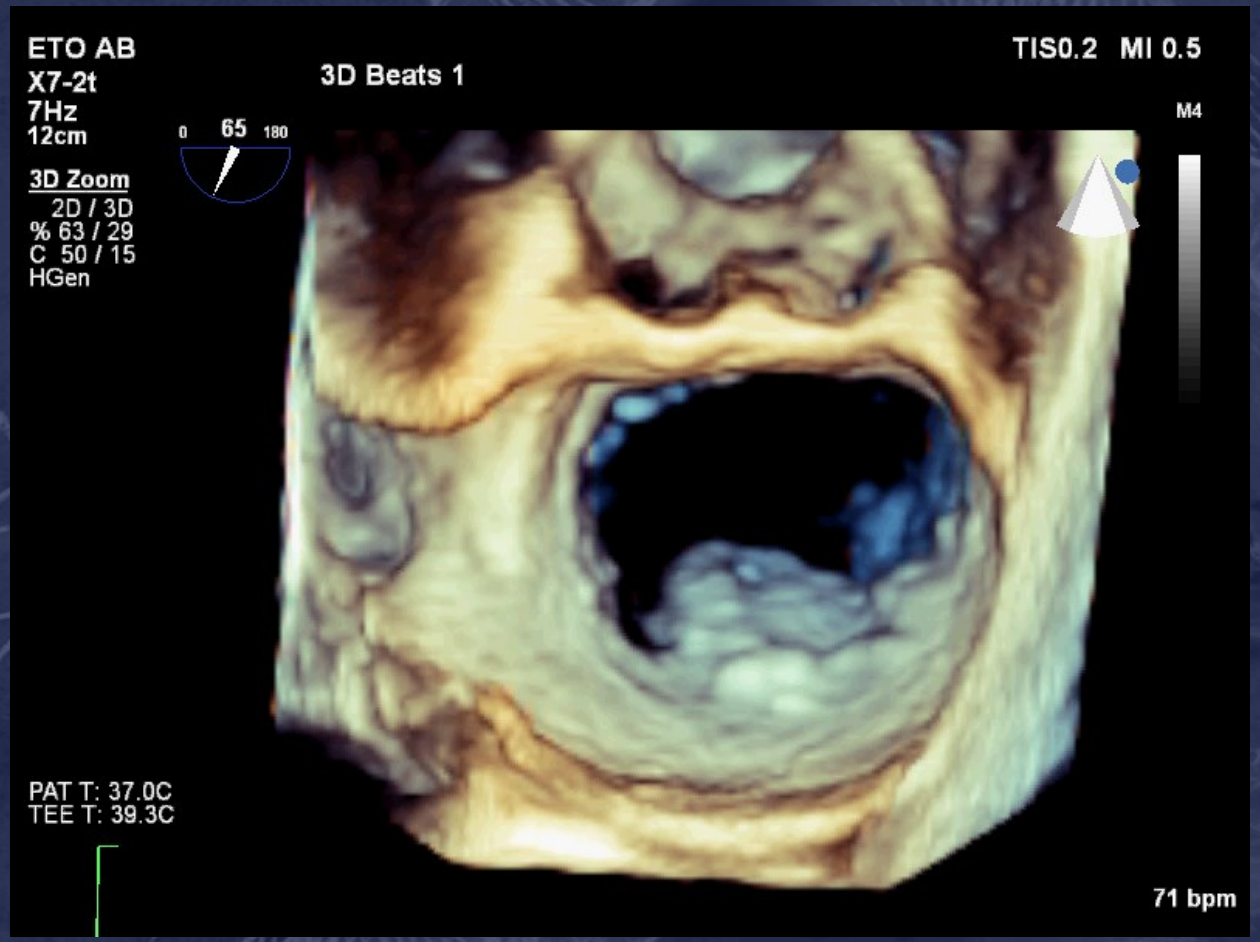
X Plane for Mitral Valve Analysis (A1P1)

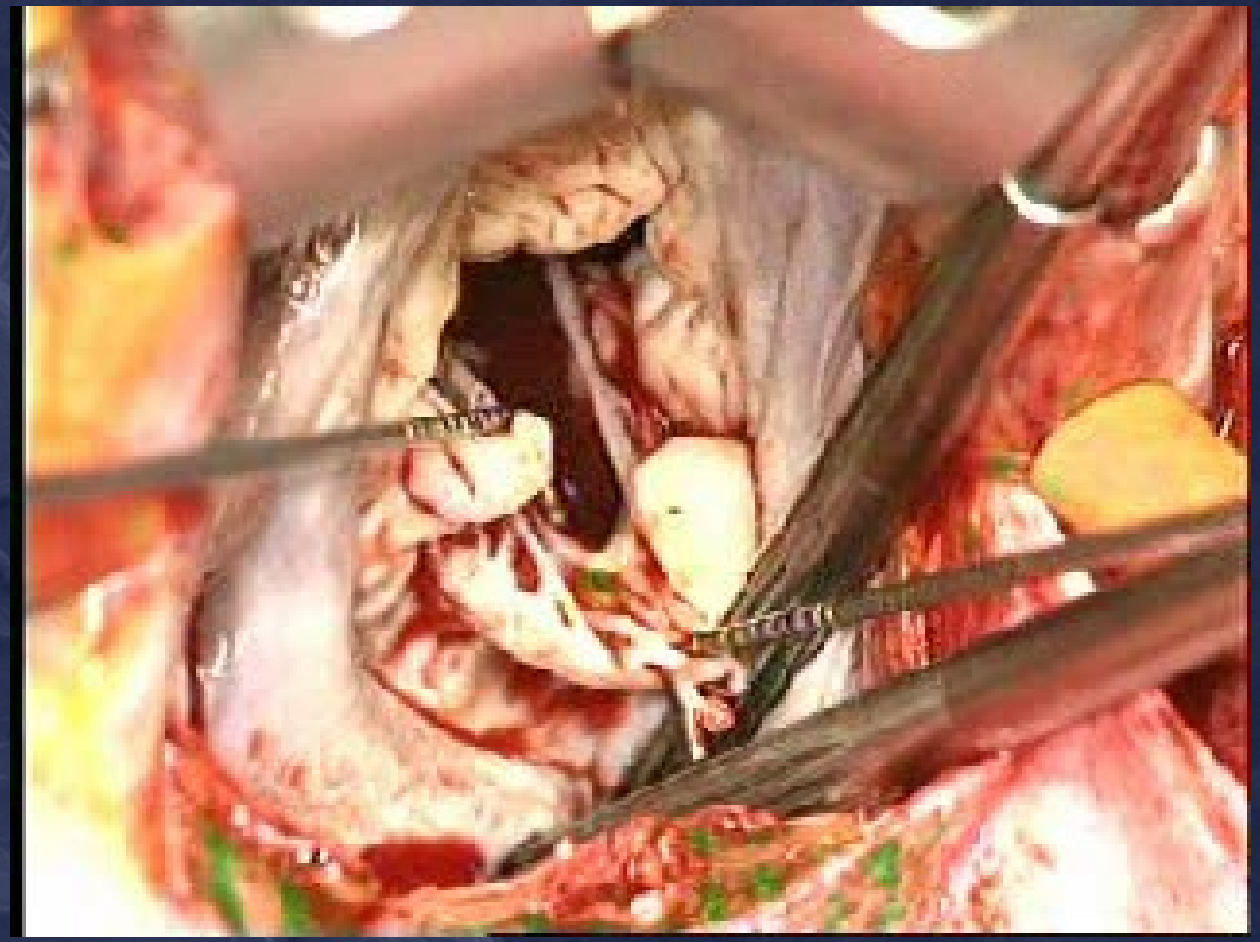


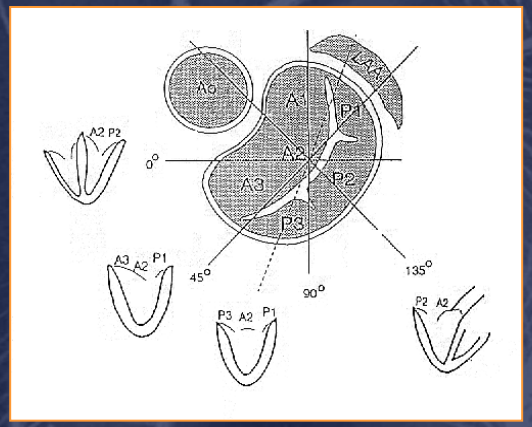
X Plane for Mitral Valve Analysis (A3P3)



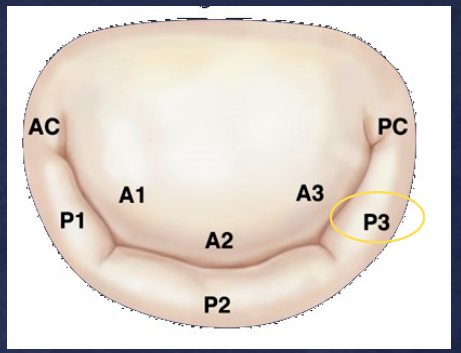

7.8cm
3D Live
3D 5%
3D 15dB
Gén
JPEG
T PAT: 37.0C
T ETO: 38.9C
*** bpm

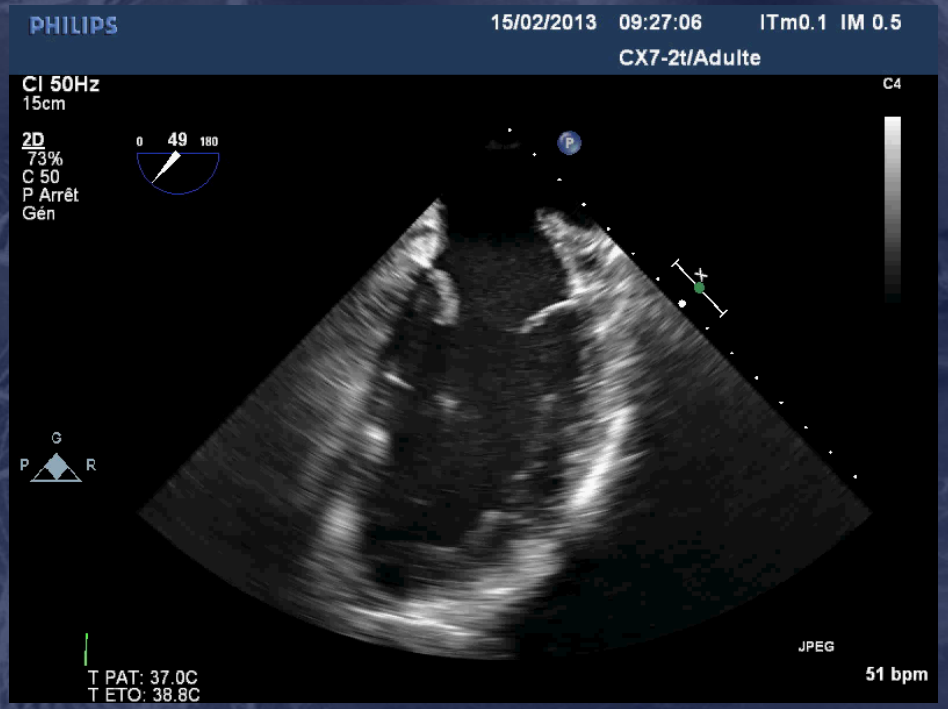

ETO AB
X7-2t
7Hz
12cm
3D Zoom
2D / 3D
% 63 / 29
C 50 / 15
HGen
3D Beats 1
TIS0.2 MI 0.5
M4
0
65
180
PAT T: 37.0C
TEE T: 39.3C
71 bpm




Ao
A1
P1
LAA
A2 P2
0°
A2
A3
P2
P3
A3 A2 P1
45°
90°
135°
P3 A2 P1
P2 A2

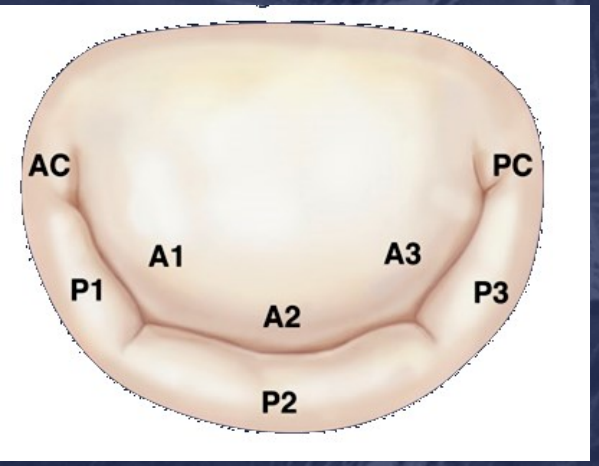
II P3

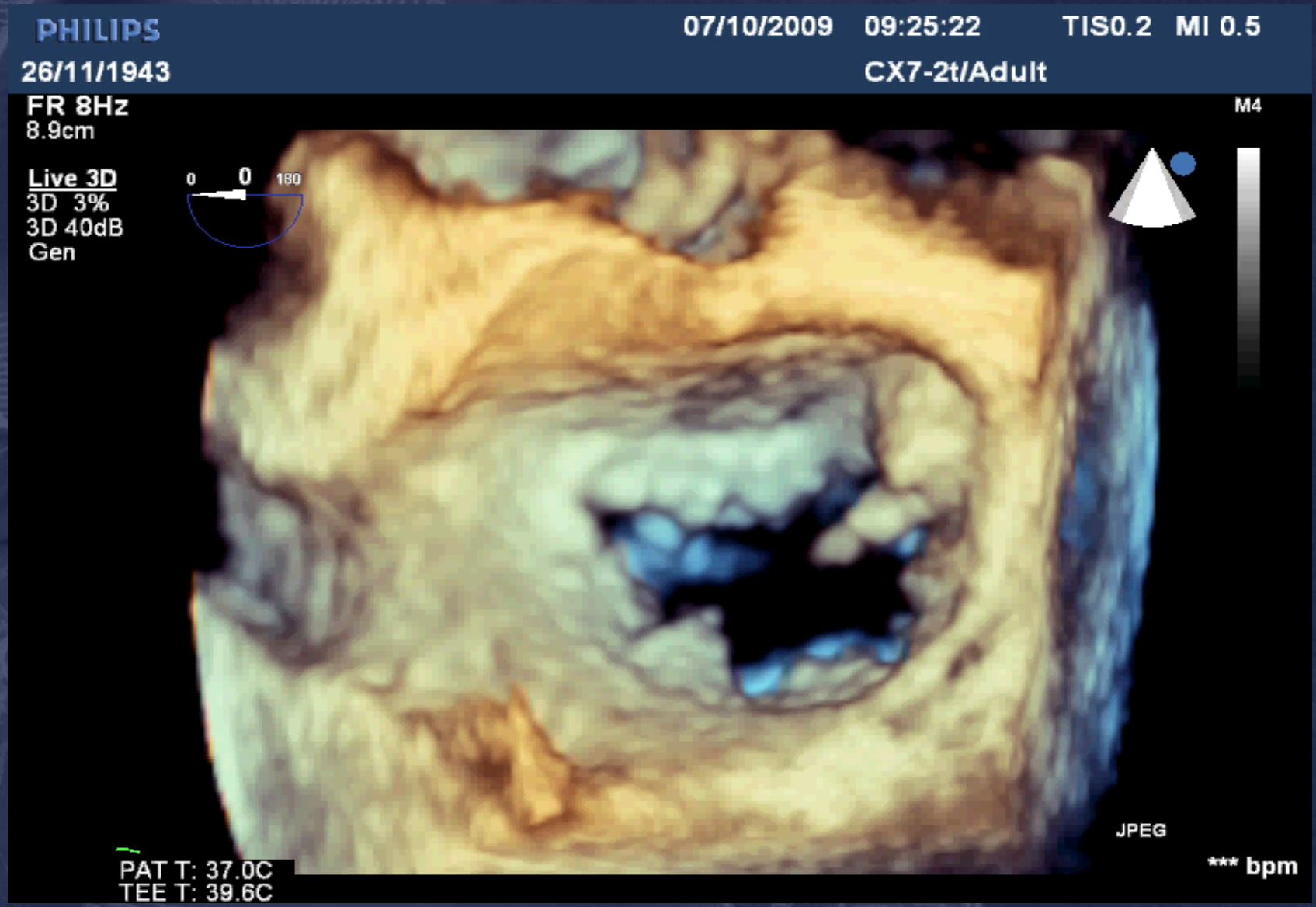

AC
PC
A1
A3
P1
P3
A2
P2

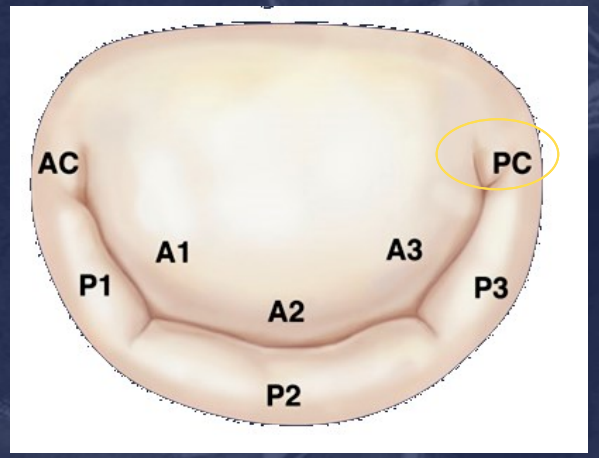

PHILIPS
15/02/2013 09:27:06 ITm0.1 IM 0.5
CX7-2t/Adulte
CI 50Hz
15cm
C4
2D
73%
C 50
P Arrêt
Gén
0 49 180
G
P R
JPEG
T PAT: 37.0C
T ETO: 38.8C
51 bpm

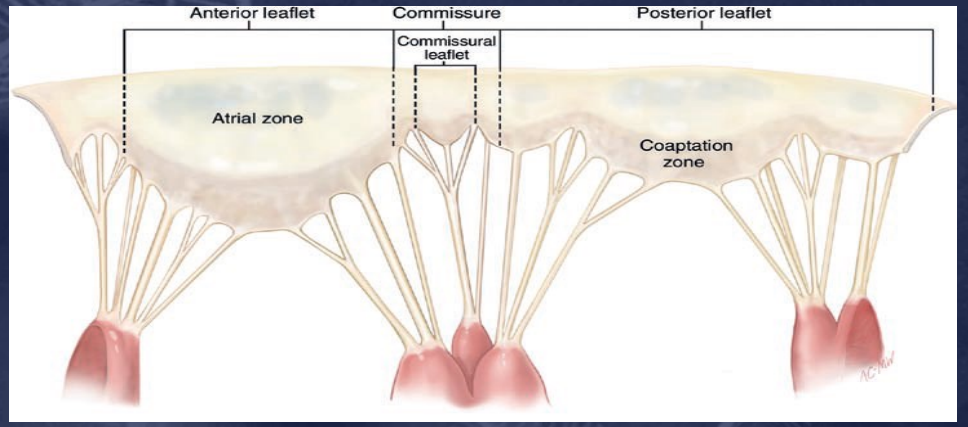

PHILIPS
15/02/2013 09:37:36 ITm0.2 IM 0.5
CX7-2t/Adulte
CI 7Hz
9.4cm
Battem. 3D 1
C4
3D
3D 52%
3D 28dB
JPEG
T PAT: 37.0C
T ETO: 39.2C
60 bpm

Commissural prolapse

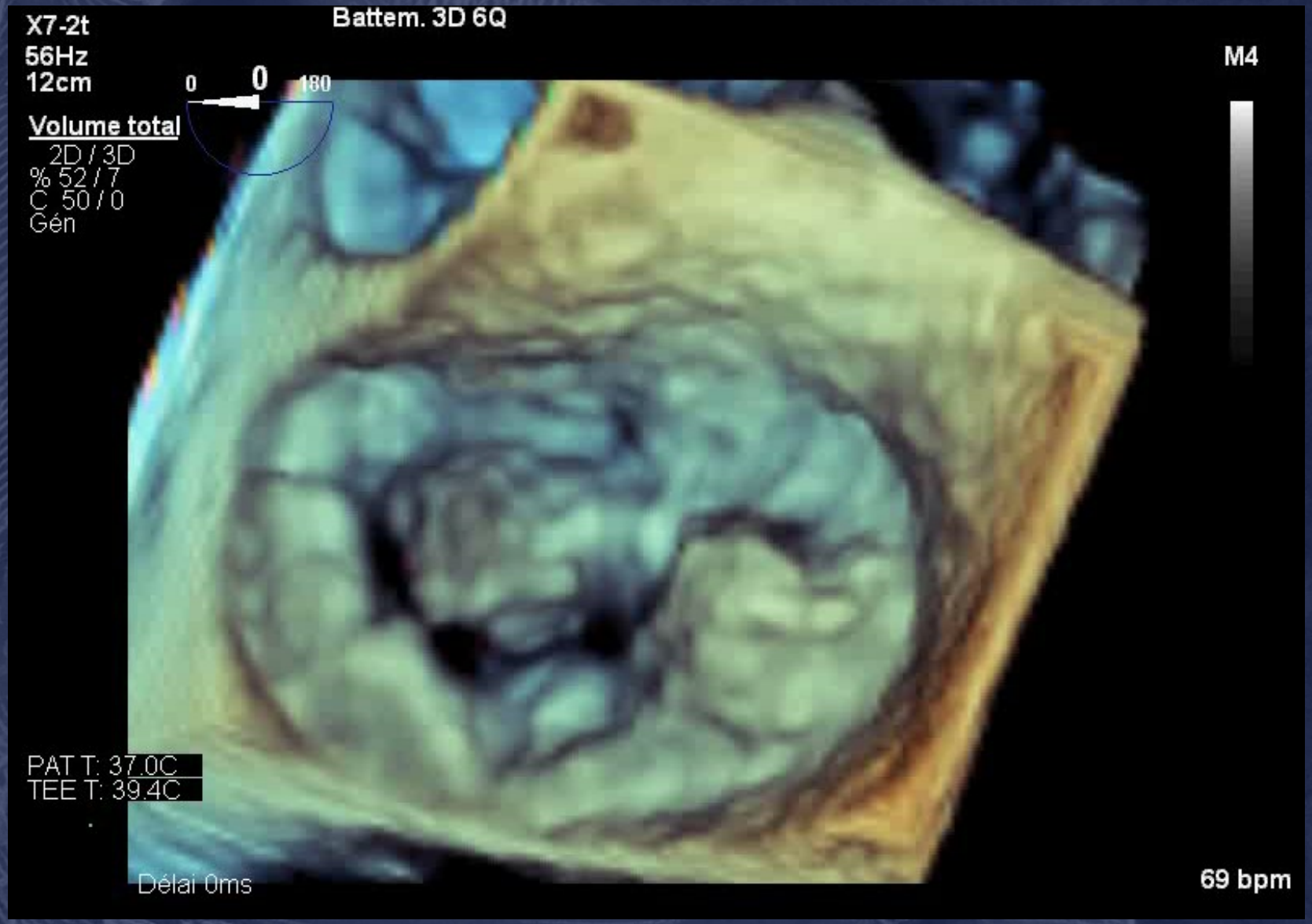




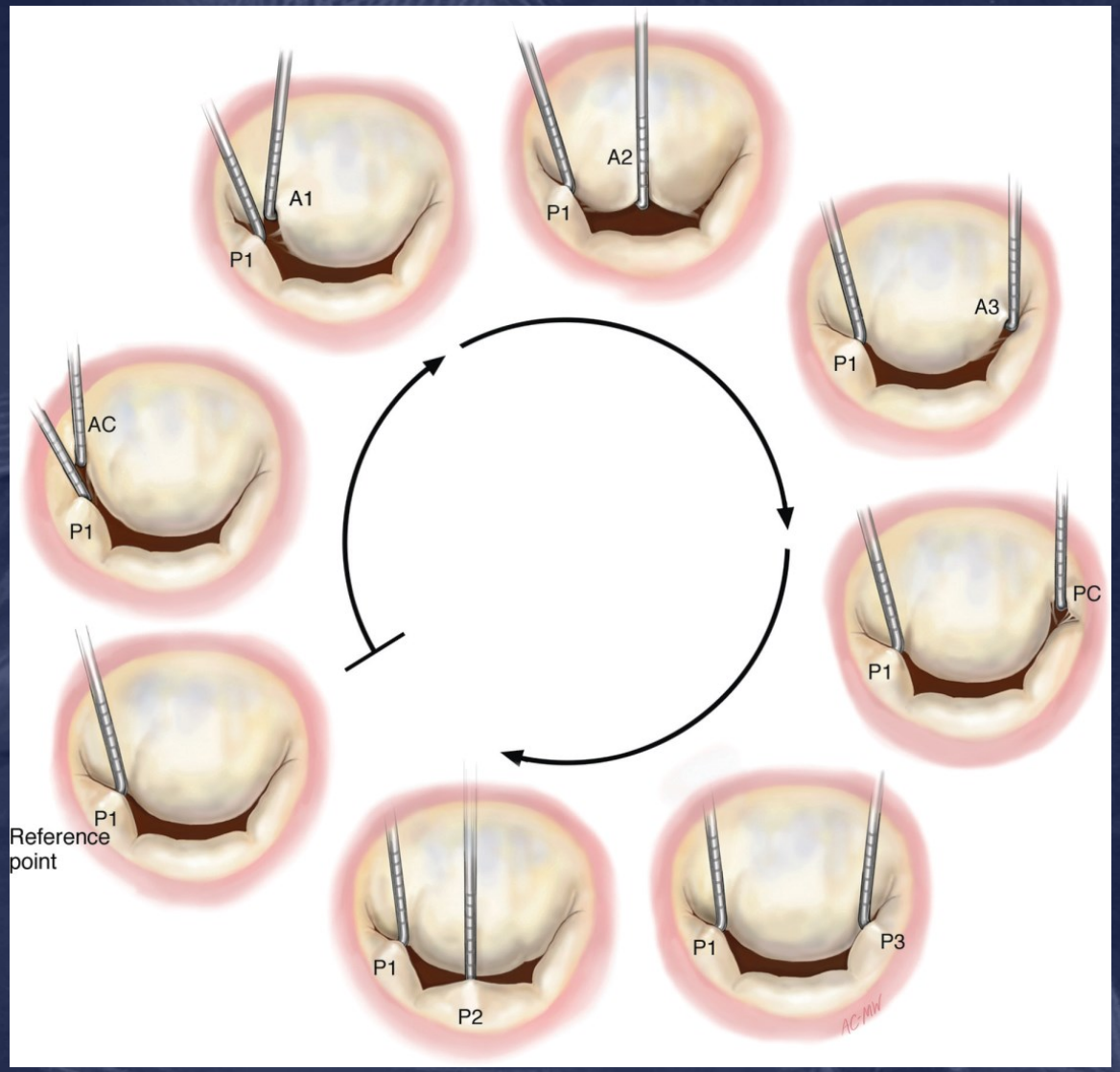

AC
PC
A1
A3
P1
P3
A2
P2


Anterior leaflet
Commissure
Posterior leaflet
Commissural leaflet
Atrial zone
Coaptation zone

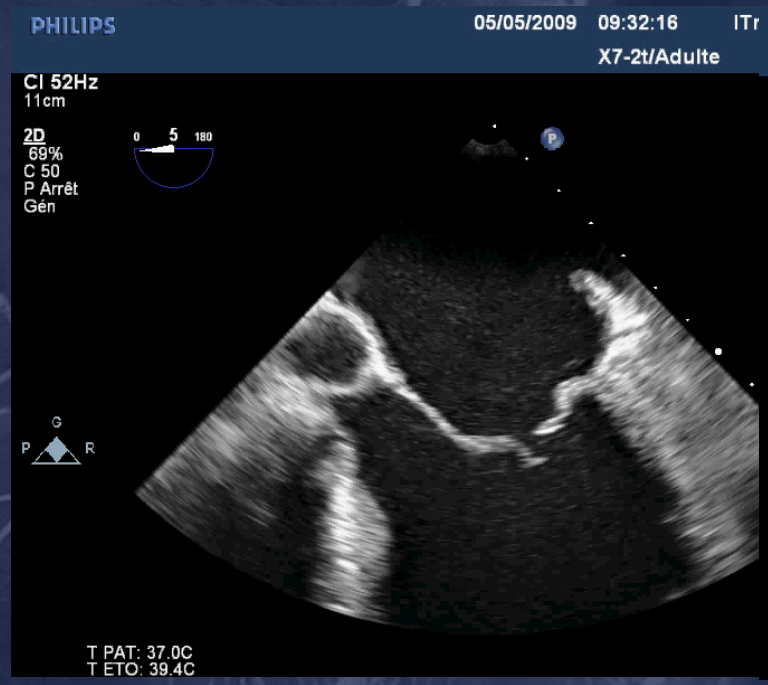
3D: complex A2P3 prolapse

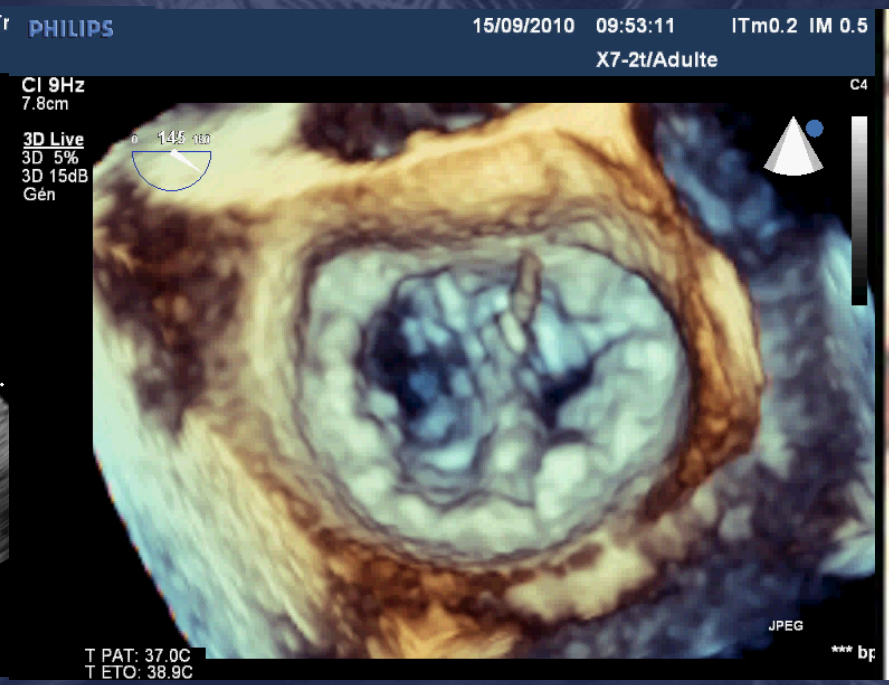


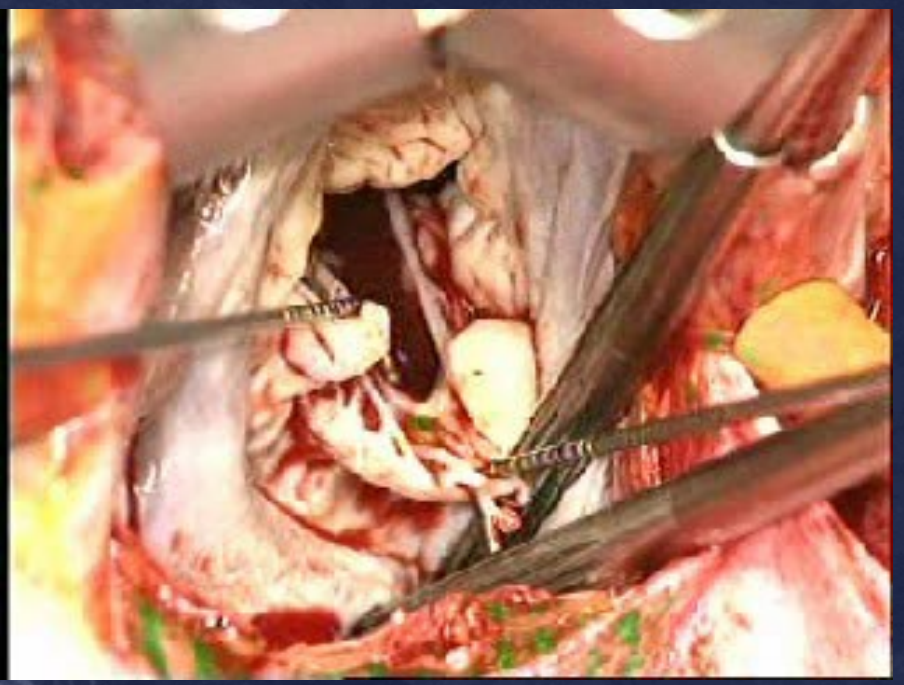
Systematic Surgical Valve Analysis



2D → 3D → Surgeon

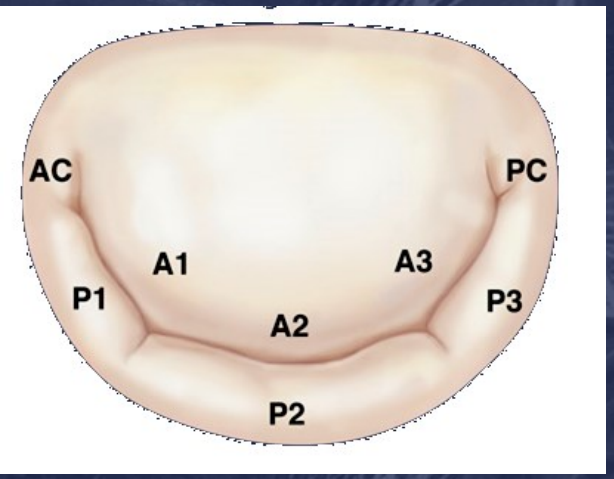


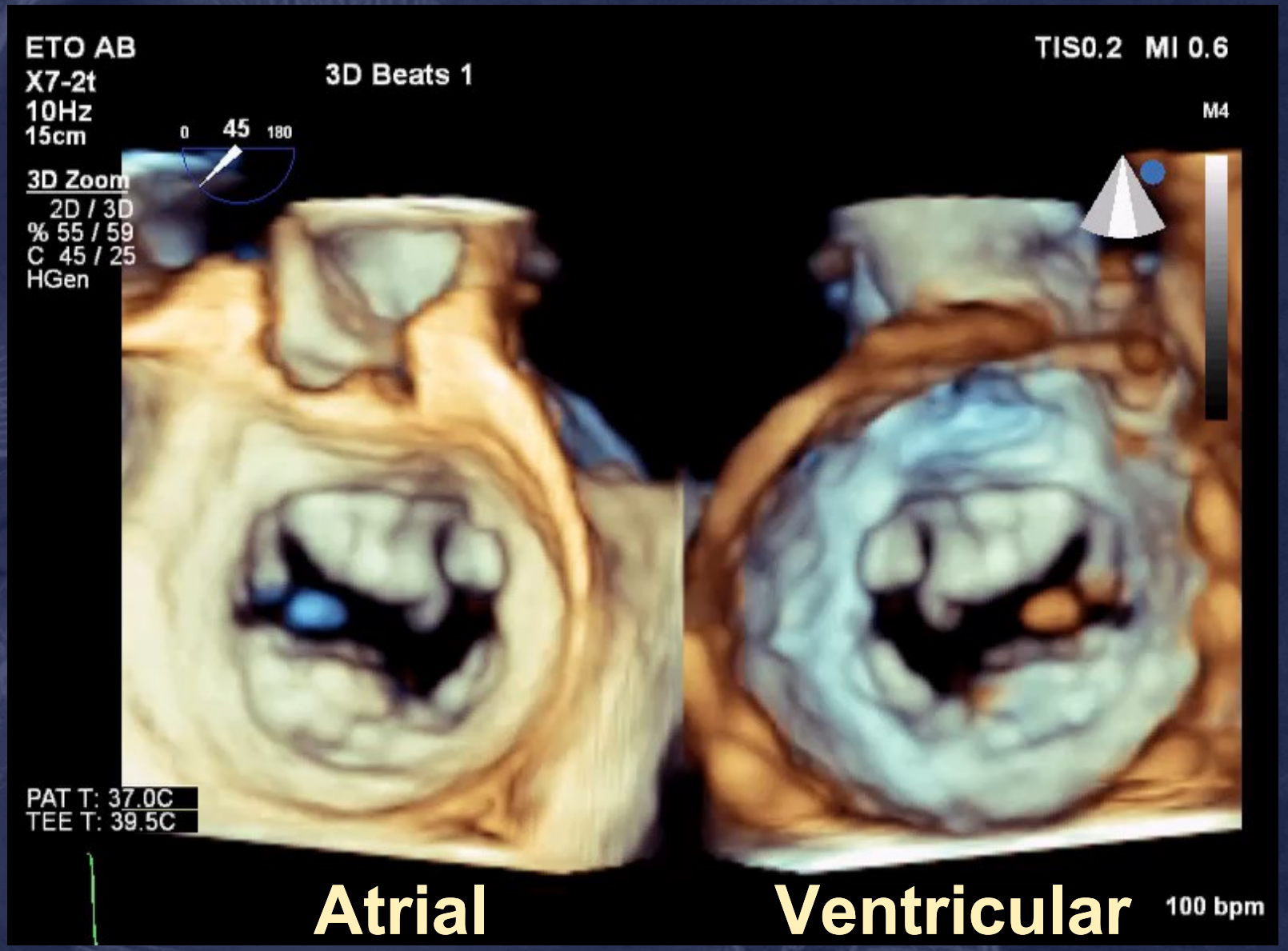




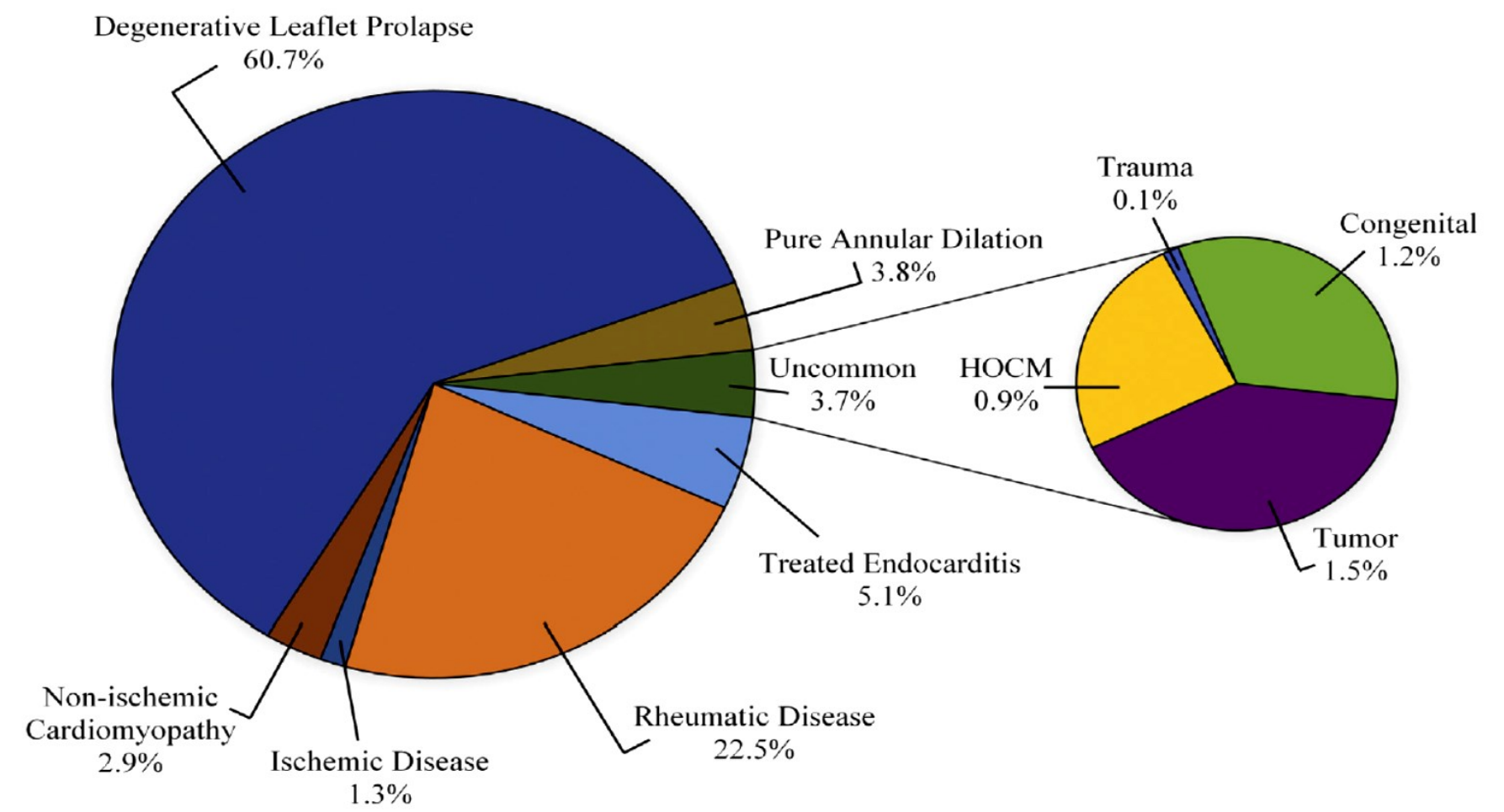
The perfect triad to improve our 3D precision

Indentation

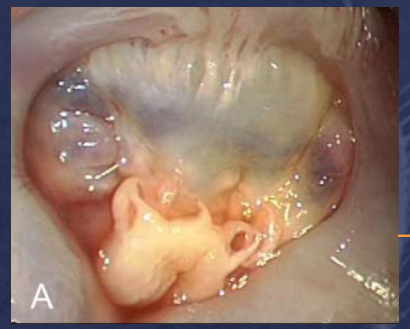




Isolated Mitral Valve Surgery: The Society of Thoracic Surgeons Adult Cardiac Surgery Database Analysis



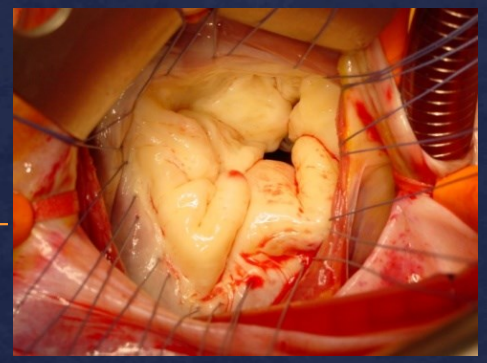
(Ann Thorac Surg 2018;106:716–27)



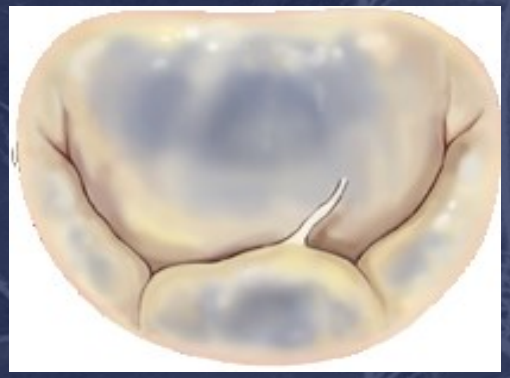
Spectrum of Degenerative MR*

**A.Carpentier. J Thorac Cardiovasc Surg 1983*

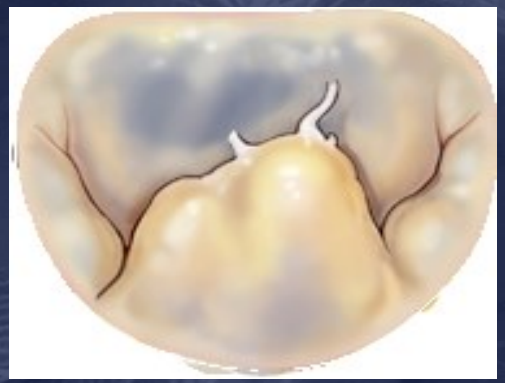
Excess of tissue ?



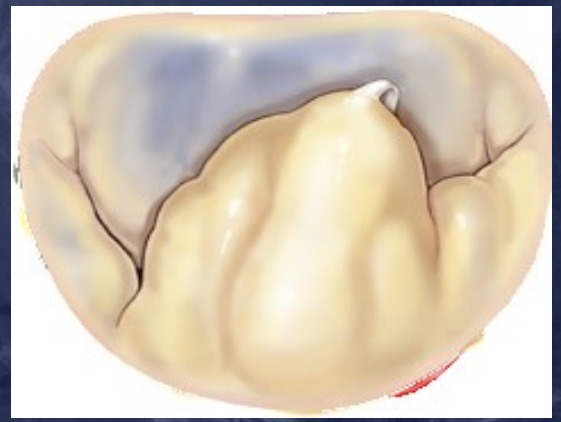
FED



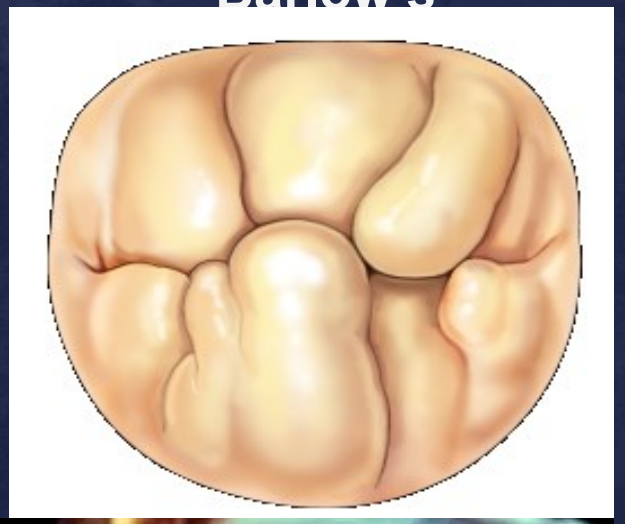
FED+



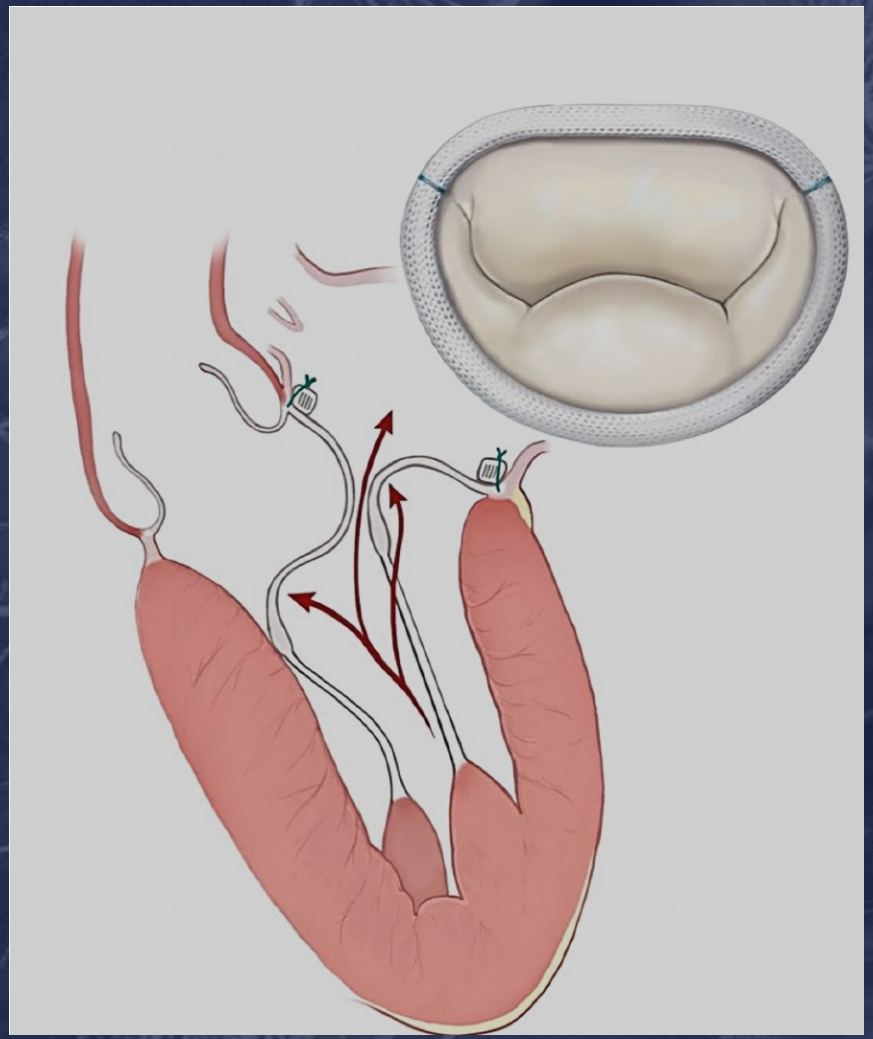
Form Fruste



Barlow's

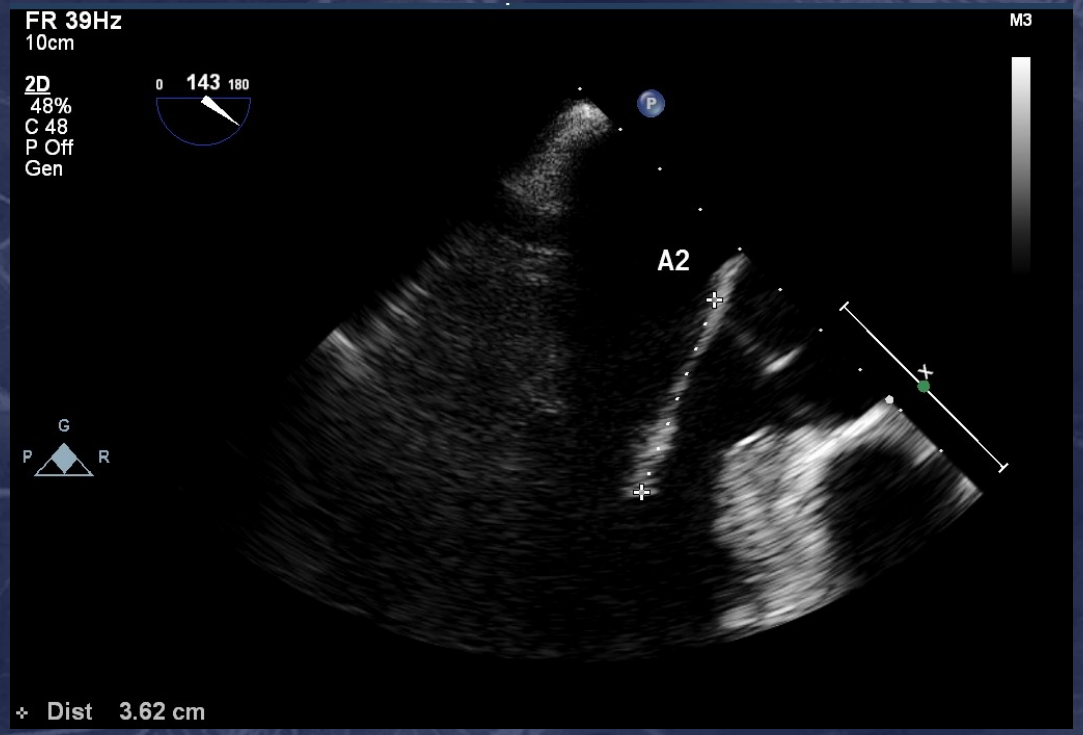


Risk of SAM



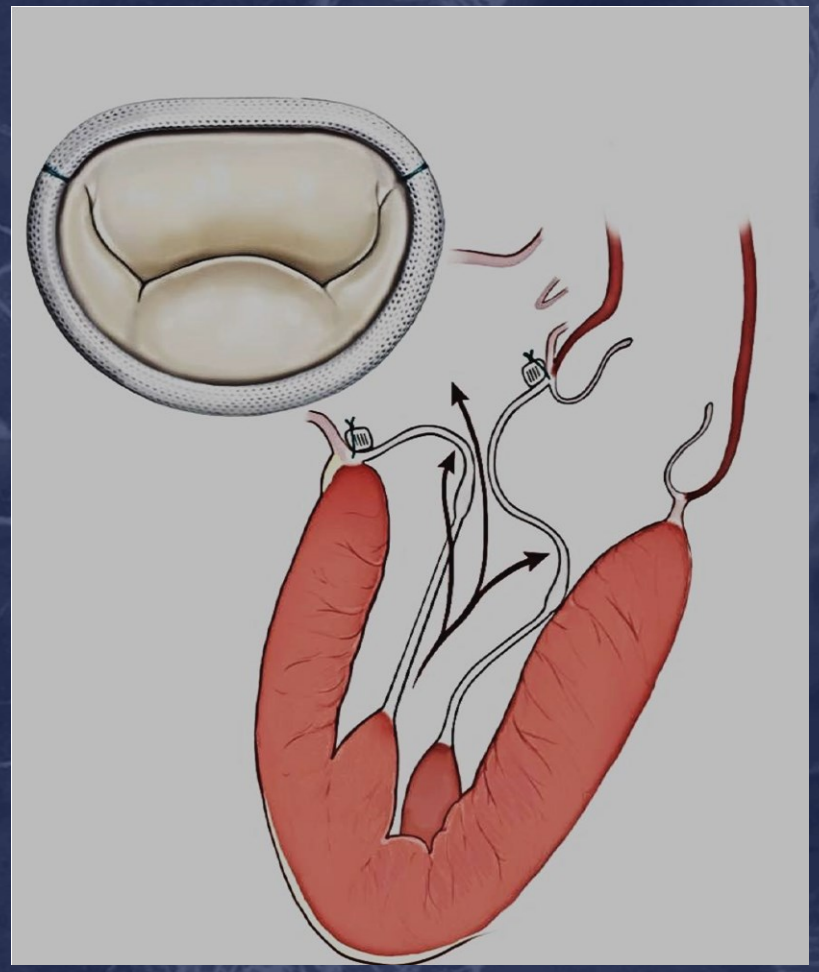
Mihaileanu.S.Circulation 1988;78 (suppll):I78-I84

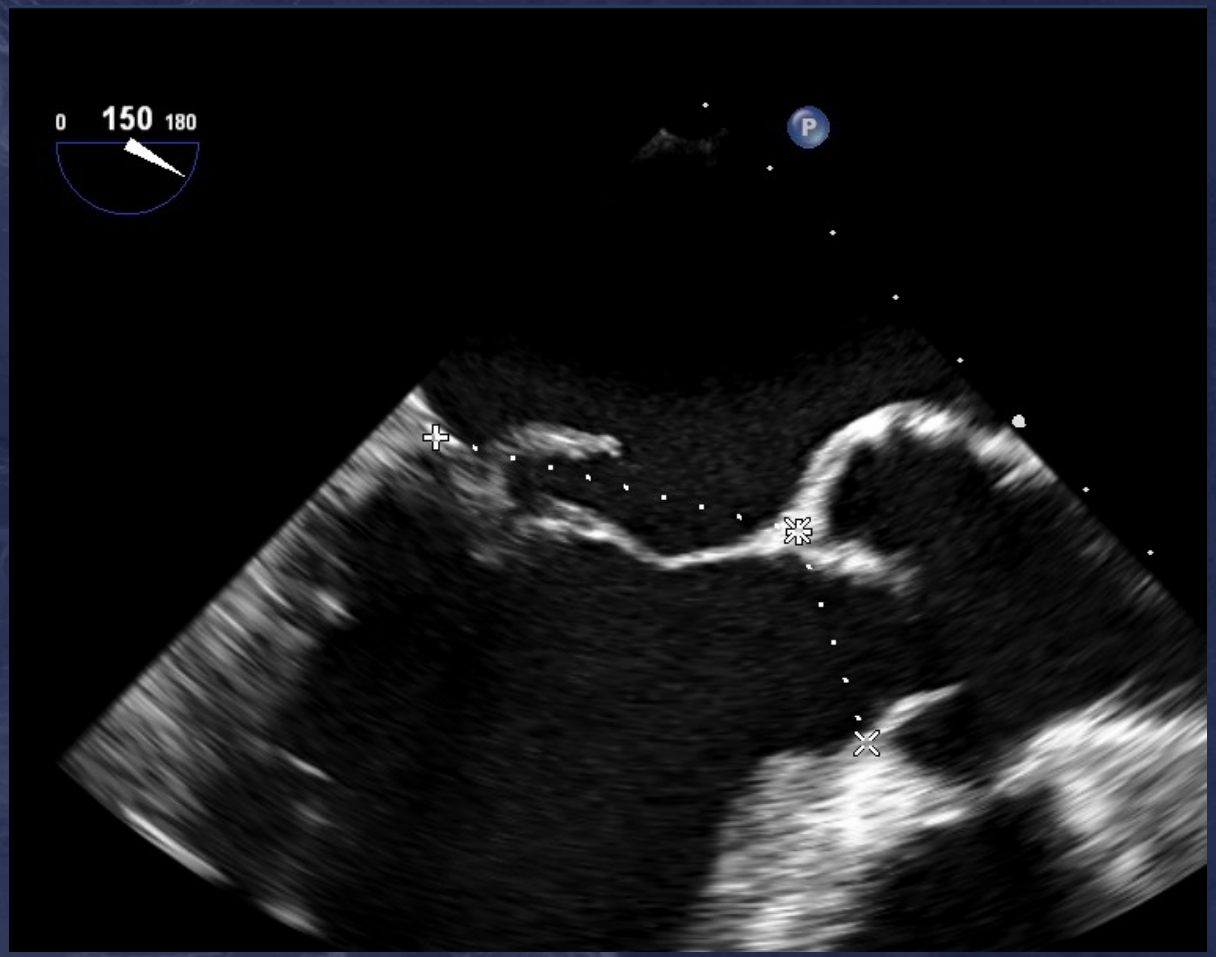
Height A2 ≈ Ring size



Never undersize in degenerative disease

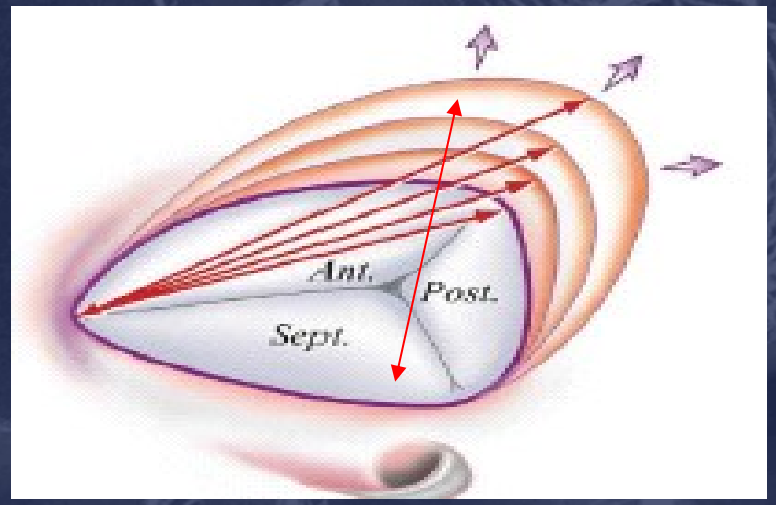
Mitro-aortic angle < 130°

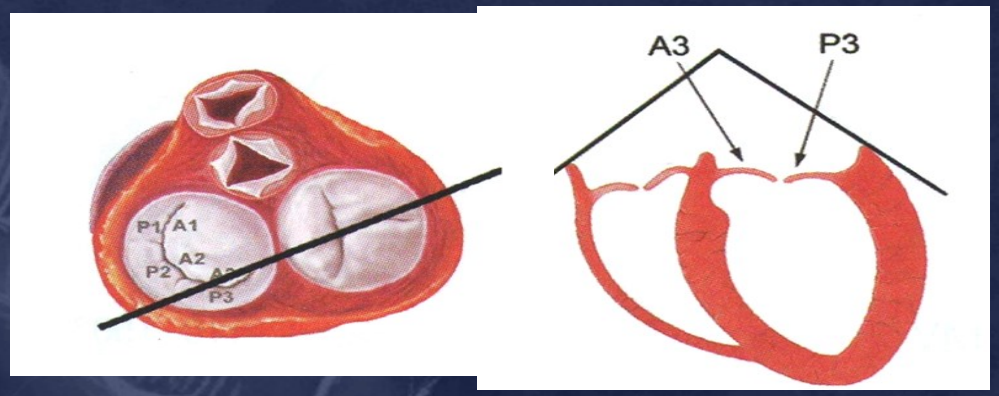




Mihaileanu.S.Circulation 1988;78 (suppll):I78-I84

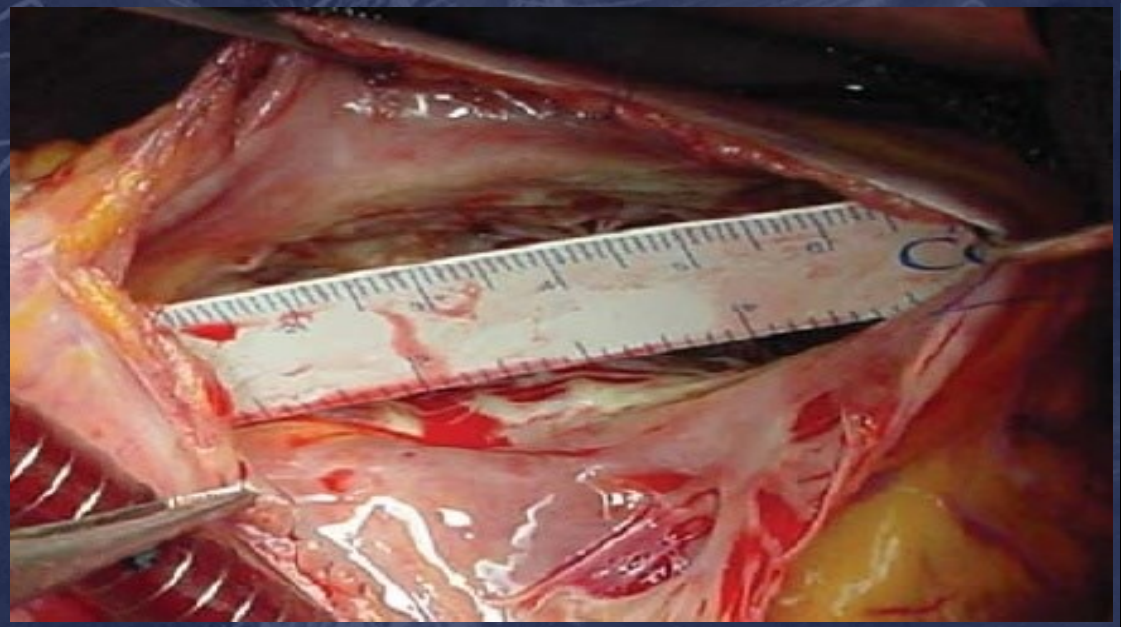
Landmark A3P3

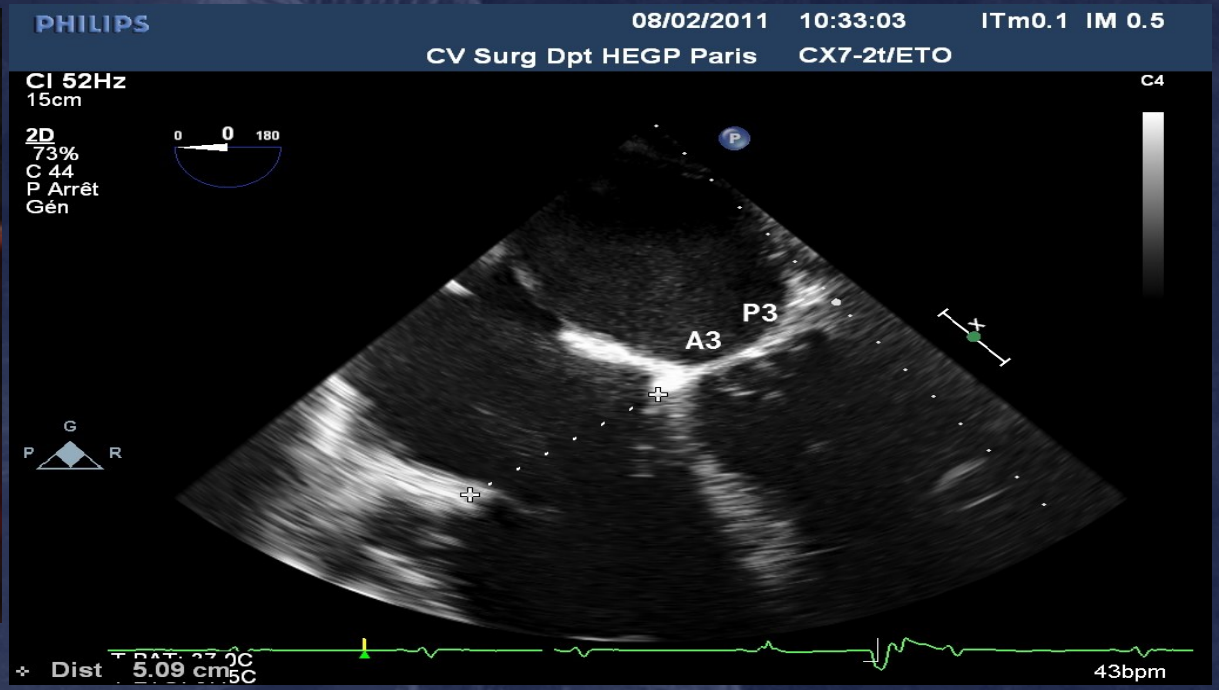




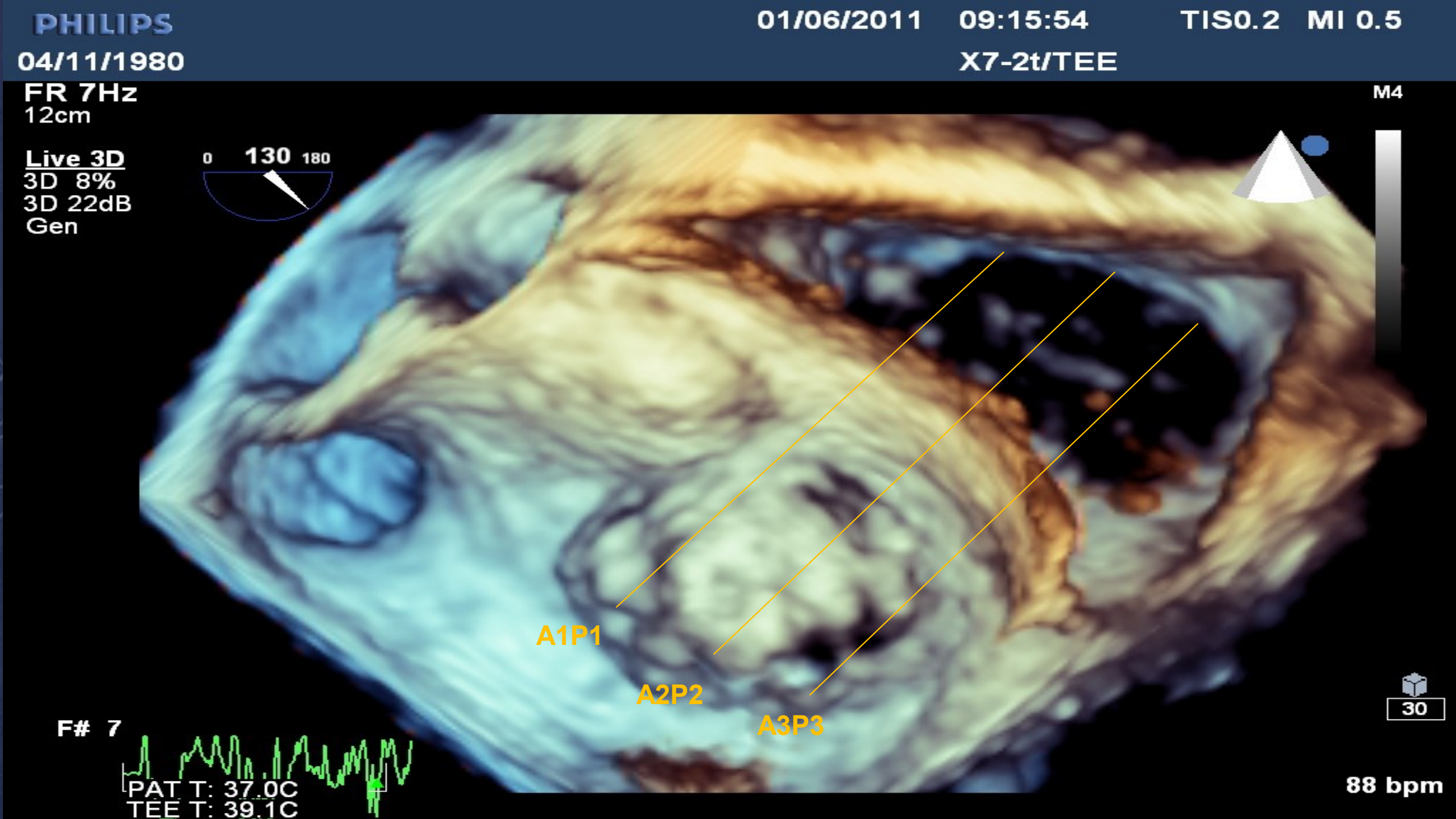
Surg:70 mm

Echo:40 mm or 21mm/m²





Dreyfus G and al. Ann Thorac Surg 2005;79:127–32


PHILIPS
01/06/2011
09:15:54
TIS0.2
MI 0.5
04/11/1980
X7-2t/TEE
FR 7Hz
12cm
M4
Live 3D
3D 8%
3D 22dB
Gen
0
130
180
A1P1
A2P2
A3P3
30
F# 7
PAT T: 37.0C
TEE T: 39.1C
88 bpm

IOE and Valve Reconstruction

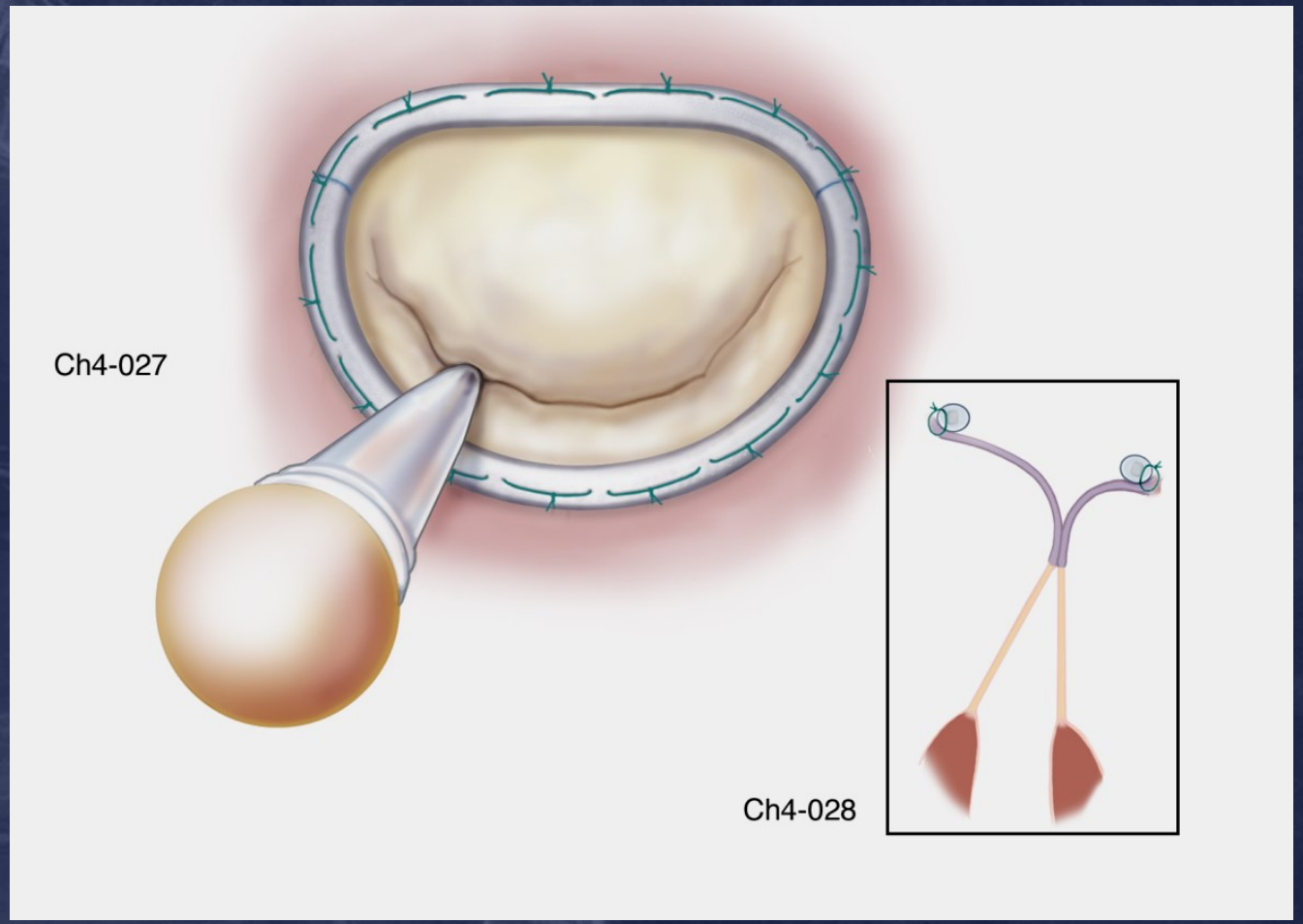
- ✓ Pre-pump: a road map
- ✓ Post pump: a safety net
- ✓ Barlow: new approach

The 3 Fundamental Principles

Restore a large surface of coaptation

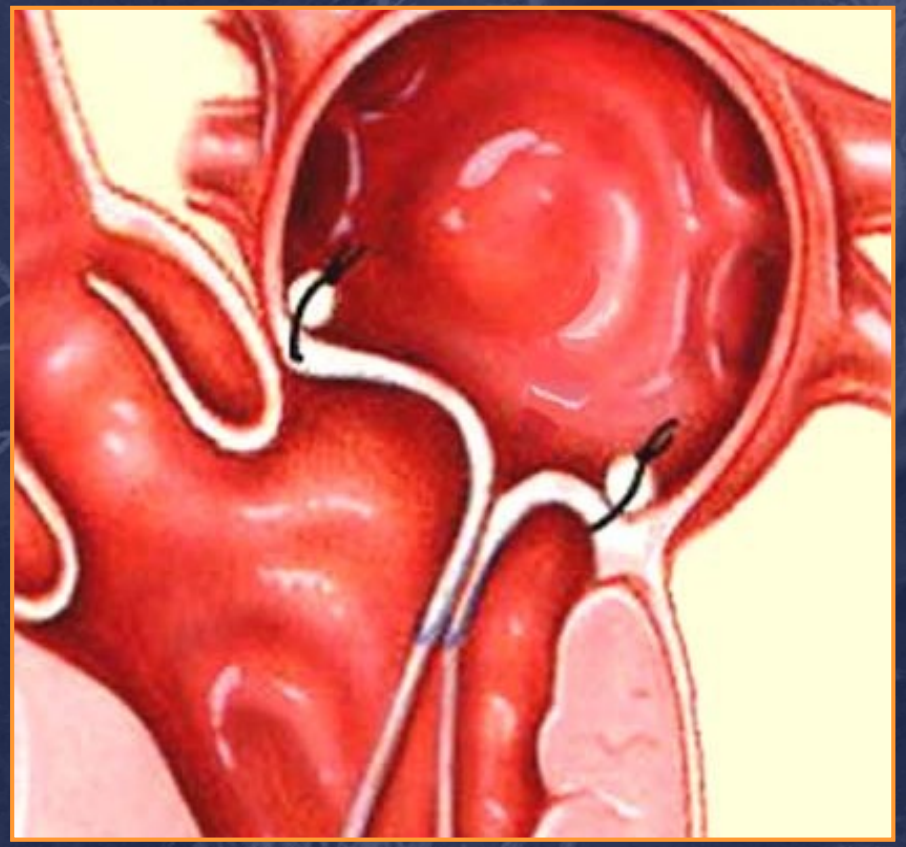
Preserve or restore full leaflet motion

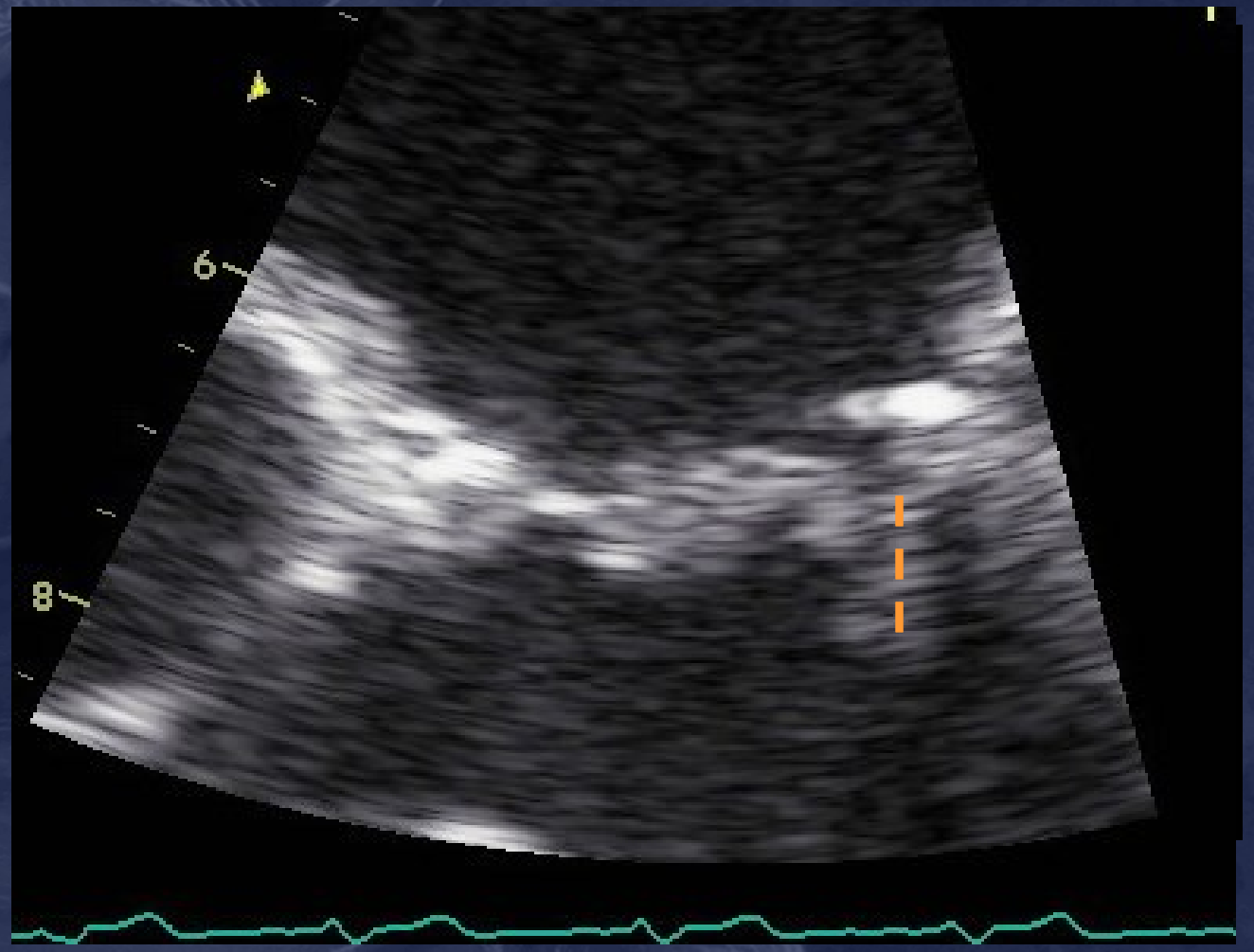
Remodel and stabilize the annulus

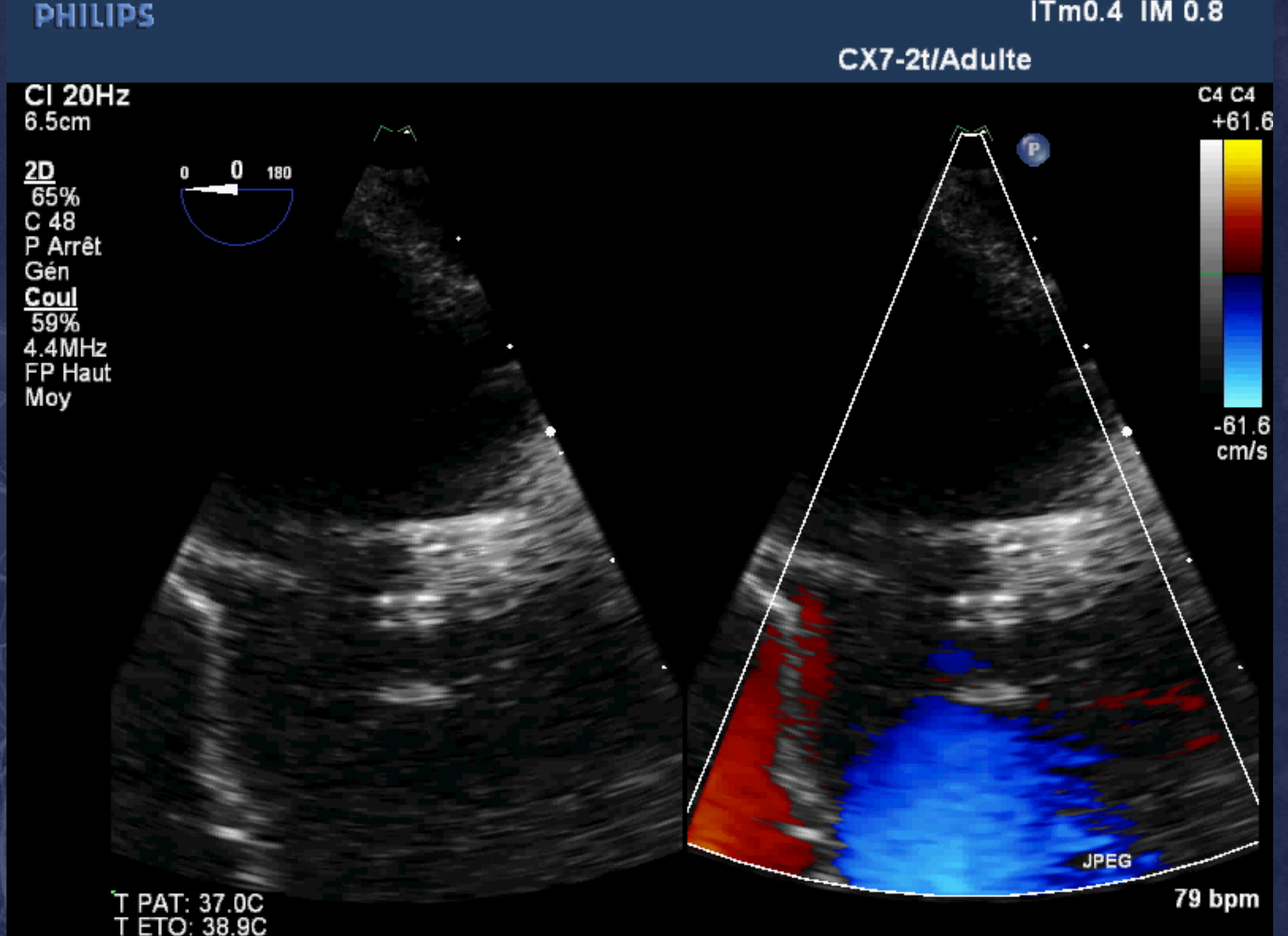


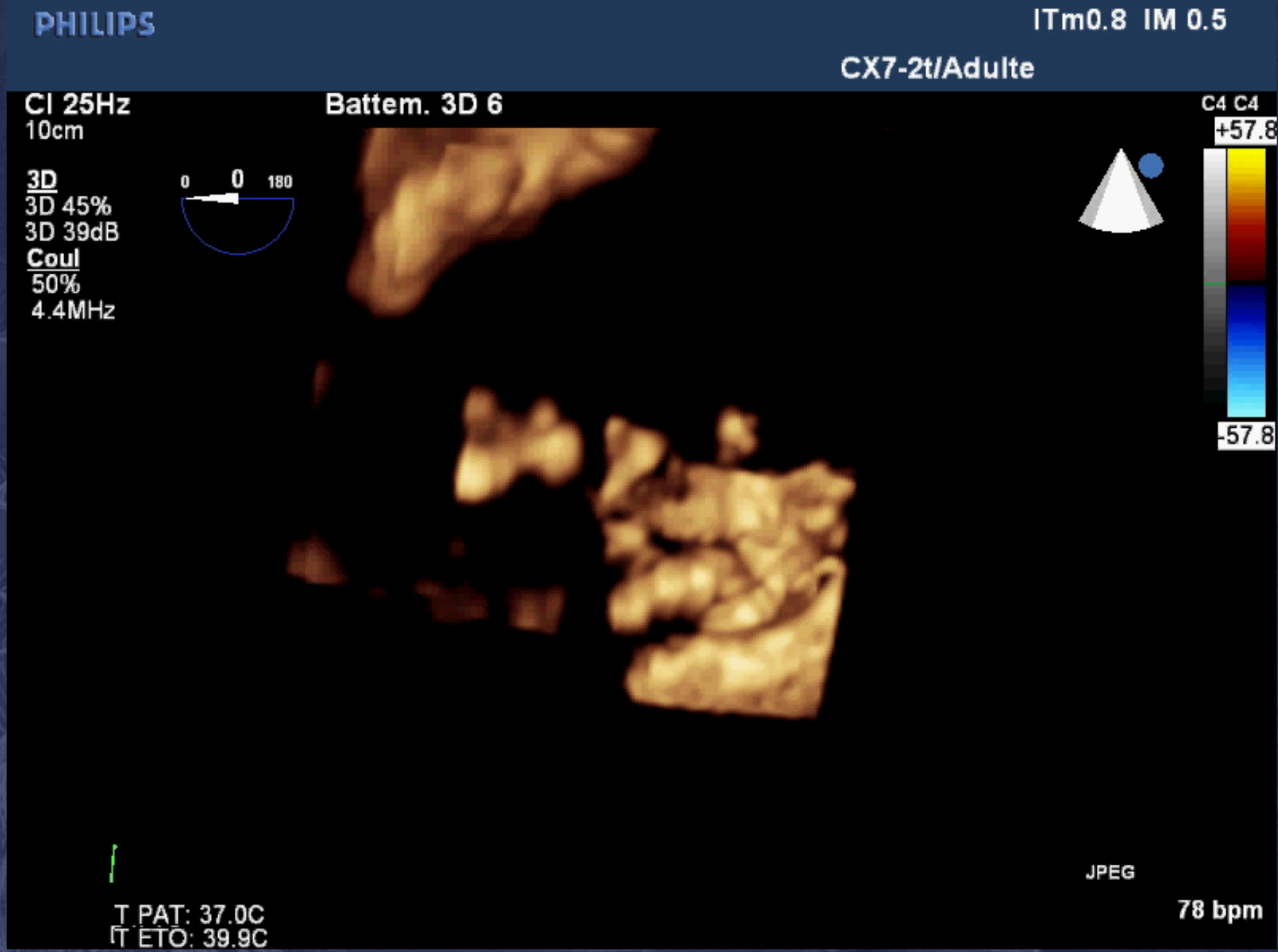
*A. Carpentier: JTCS 1983;86(3):323-37

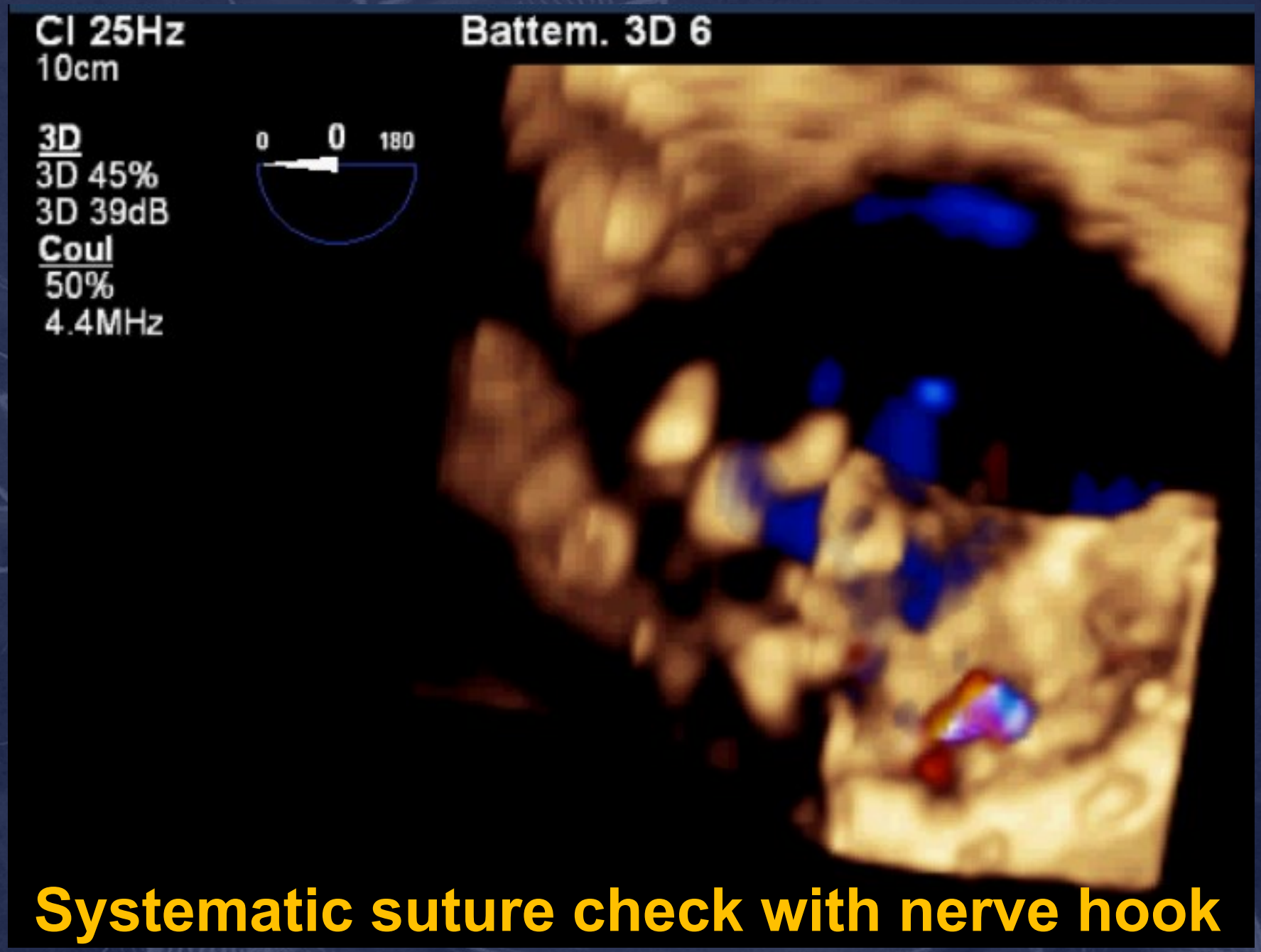
Large Surface of Coaptation (dist 6-8 mm)

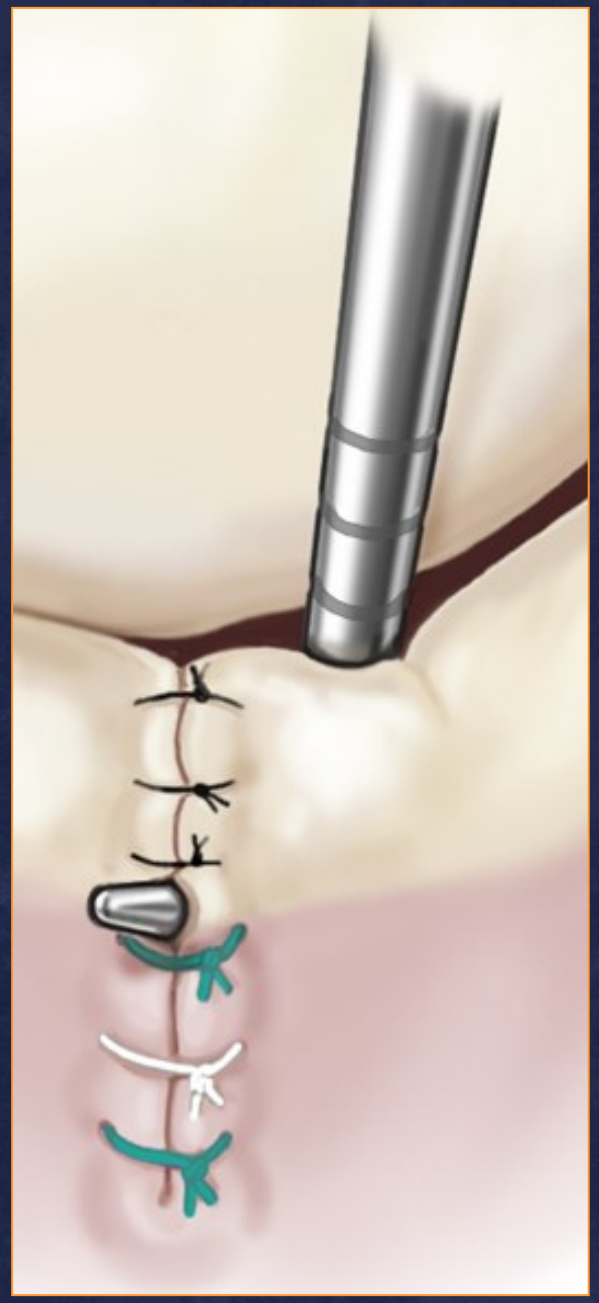




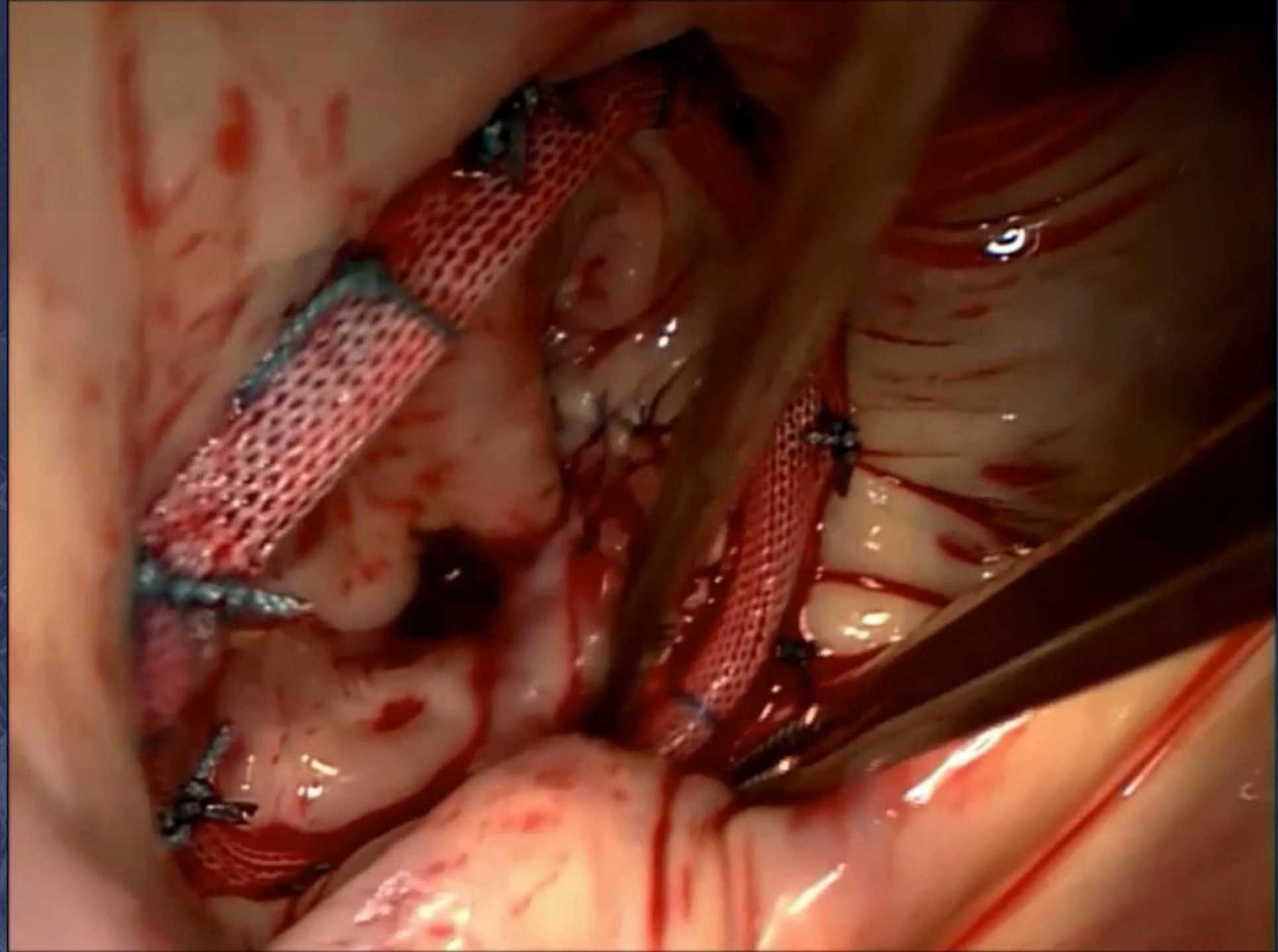

PHILIPS
ITm0.4 IM 0.8
CX7-2t/Adulte
CI 20Hz
6.5cm
2D
65%
C 48
P Arrêt
Gén
Coul
59%
4.4MHz
FP Haut
Moy
0 0 180
C4 C4
+61.6
-61.6
cm/s
JPEG
T PAT: 37.0C
T ETO: 38.9C
79 bpm

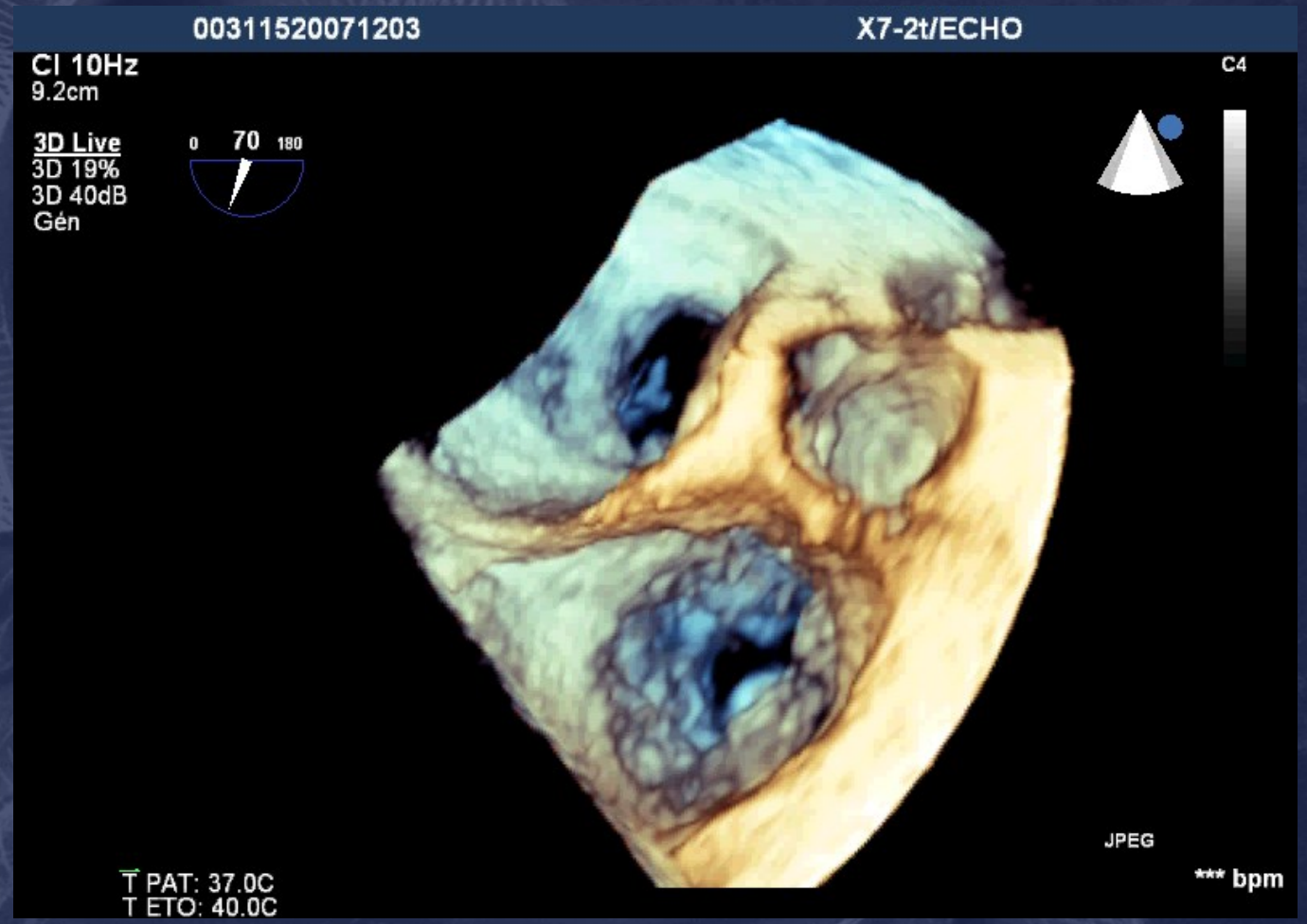

PHILIPS
ITm0.8 IM 0.5
CX7-2t/Adulte
CI 25Hz
10cm
Battem. 3D 6
C4 C4
+57.8
-57.8
3D
3D 45%
3D 39dB
Coul
50%
4.4MHz
0
0
180
JPEG
78 bpm
T PAT: 37.0C
T ETO: 39.9C

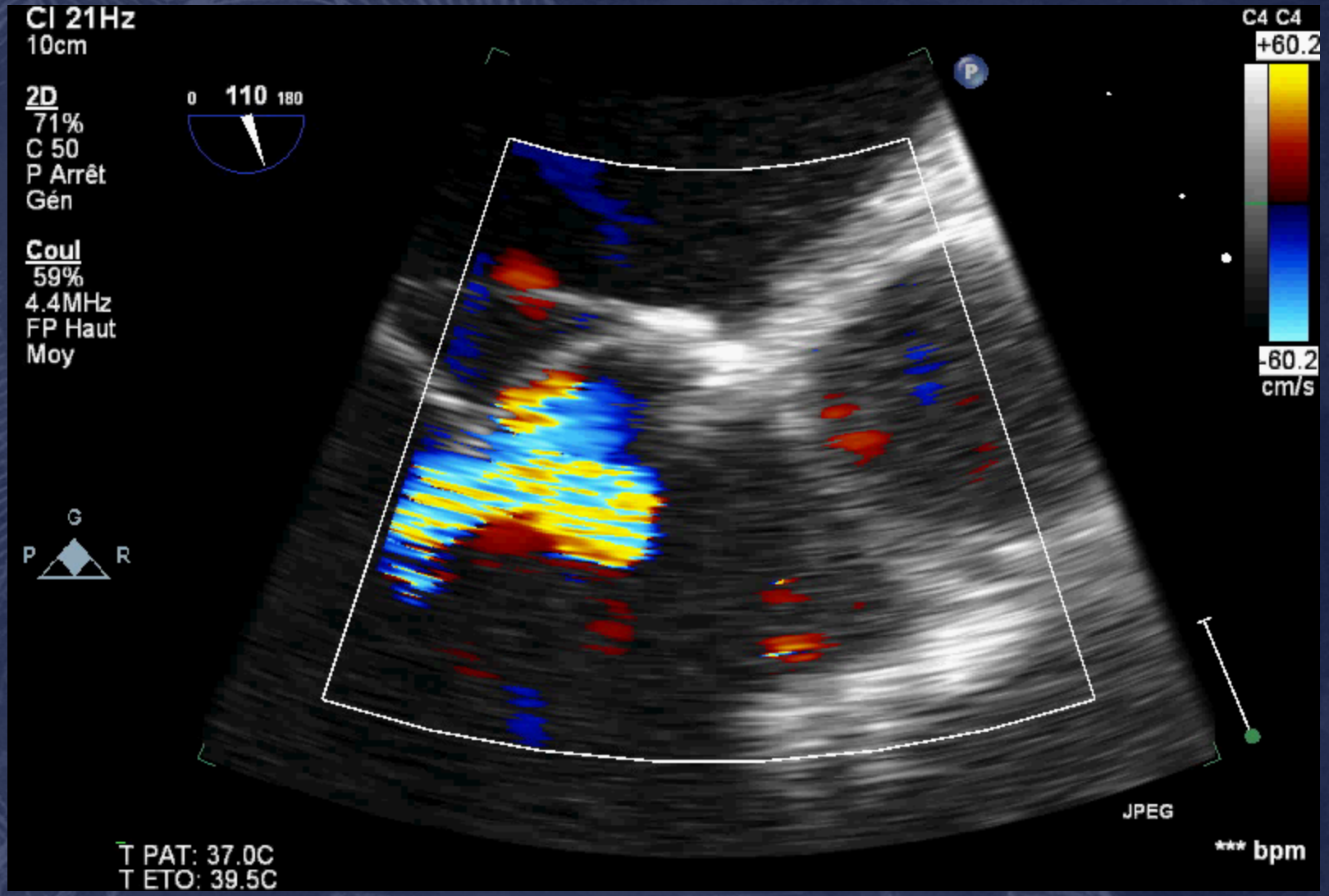


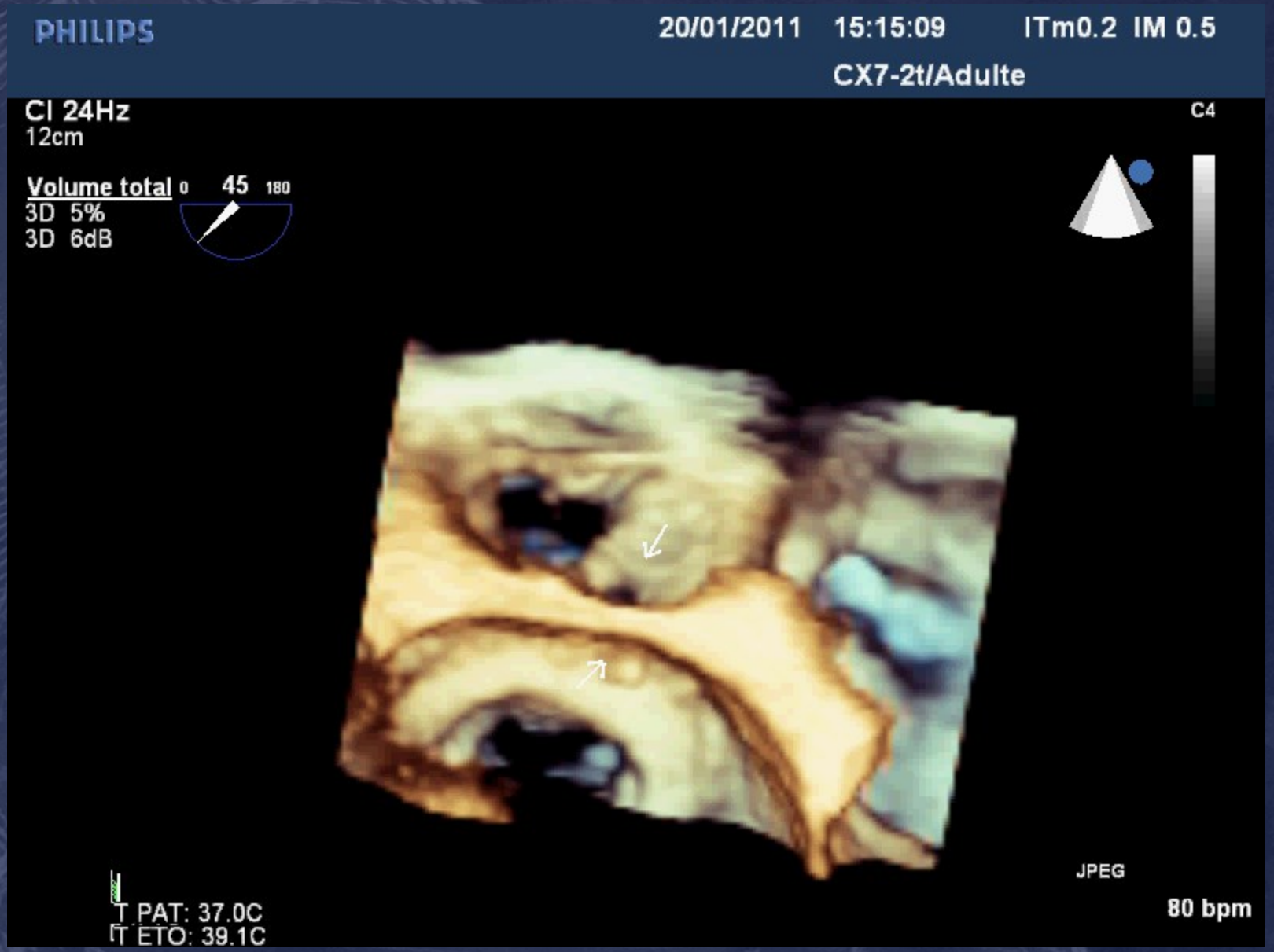


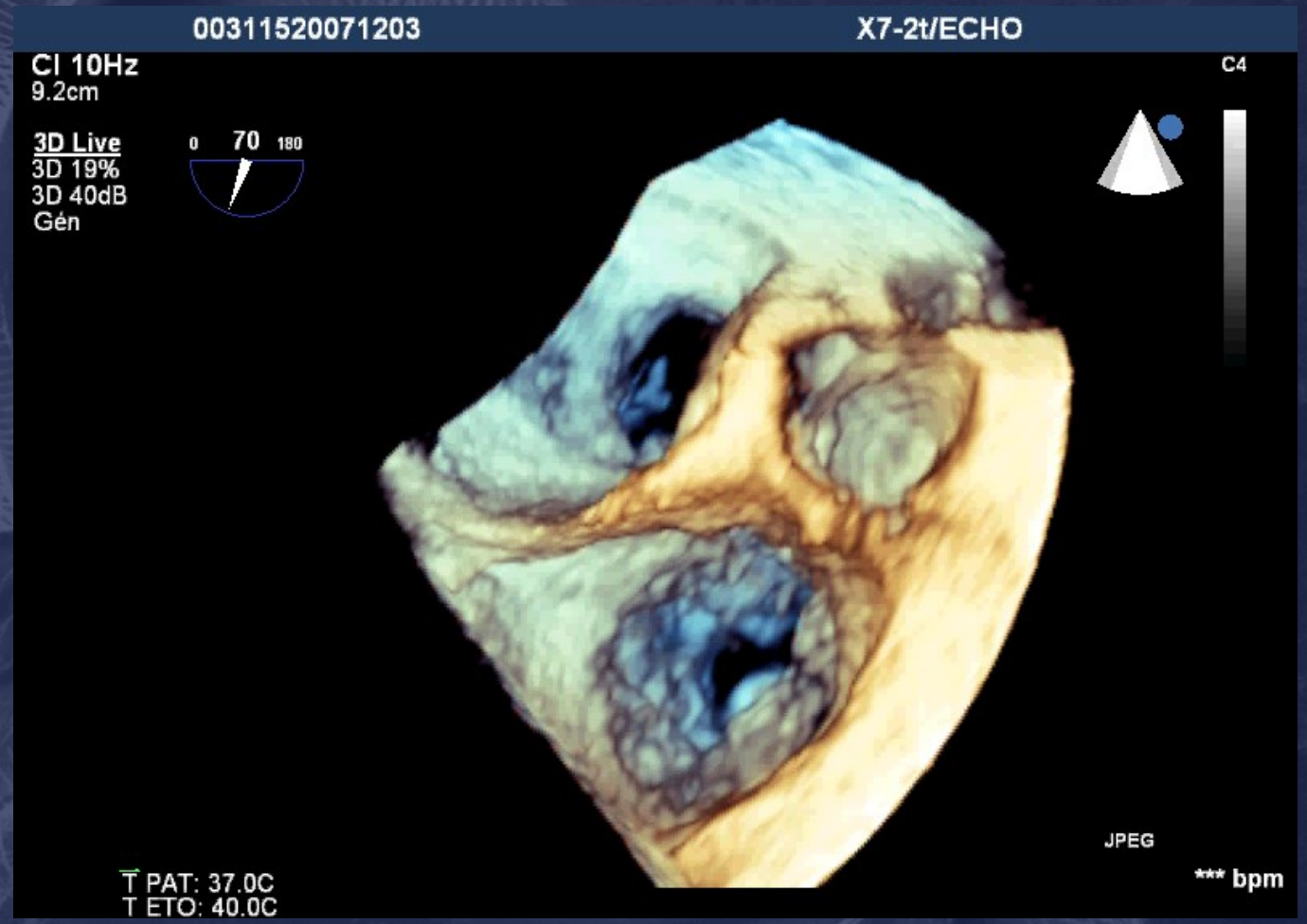
Systematic suture check with nerve hook



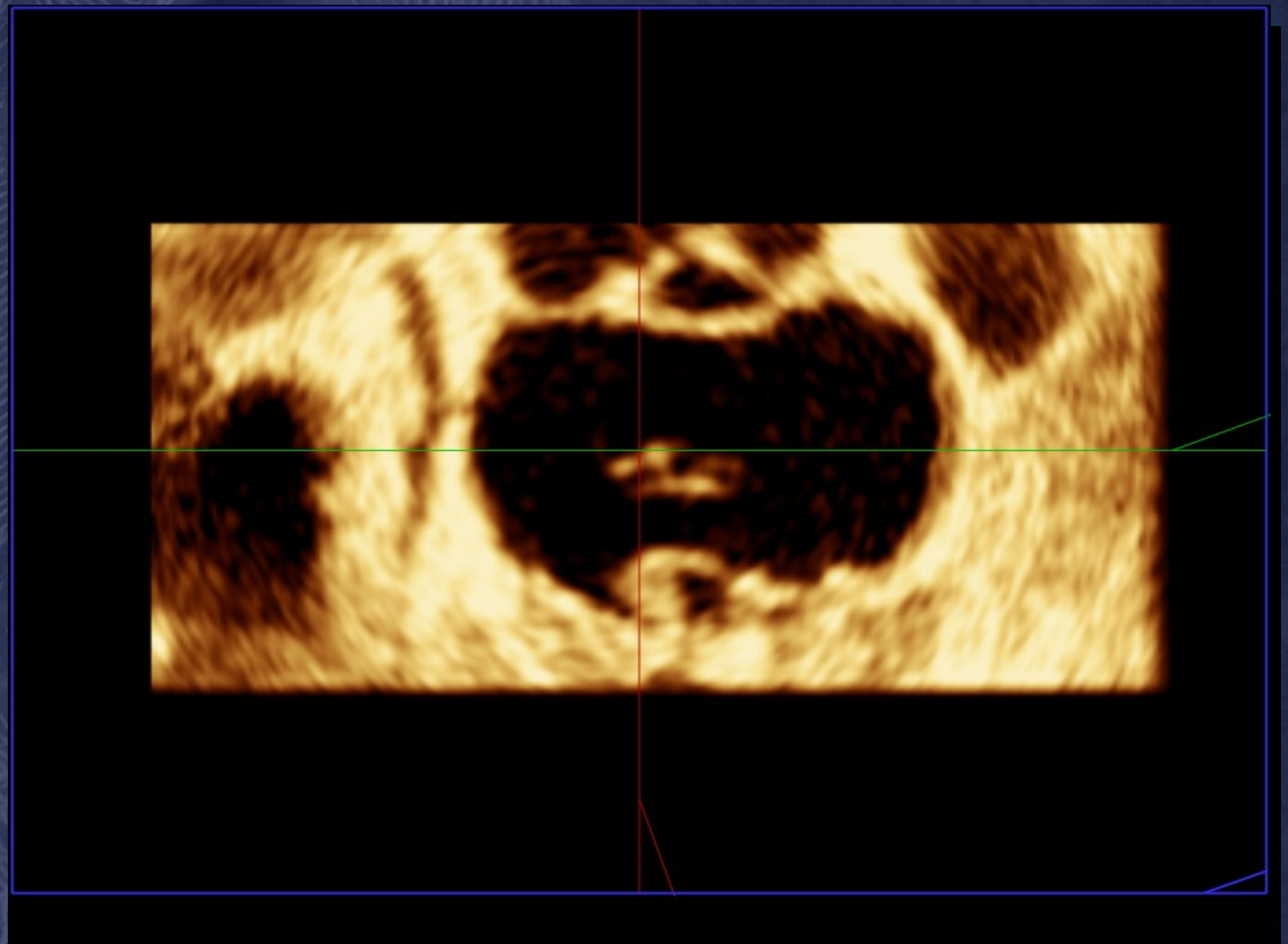

00311520071203
X7-2t/ECHO
CI 10Hz
9.2cm
C4
3D Live
3D 19%
3D 40dB
Gén
0
70
180
JPEG
*** bpm
T PAT: 37.0C
T ETO: 40.0C

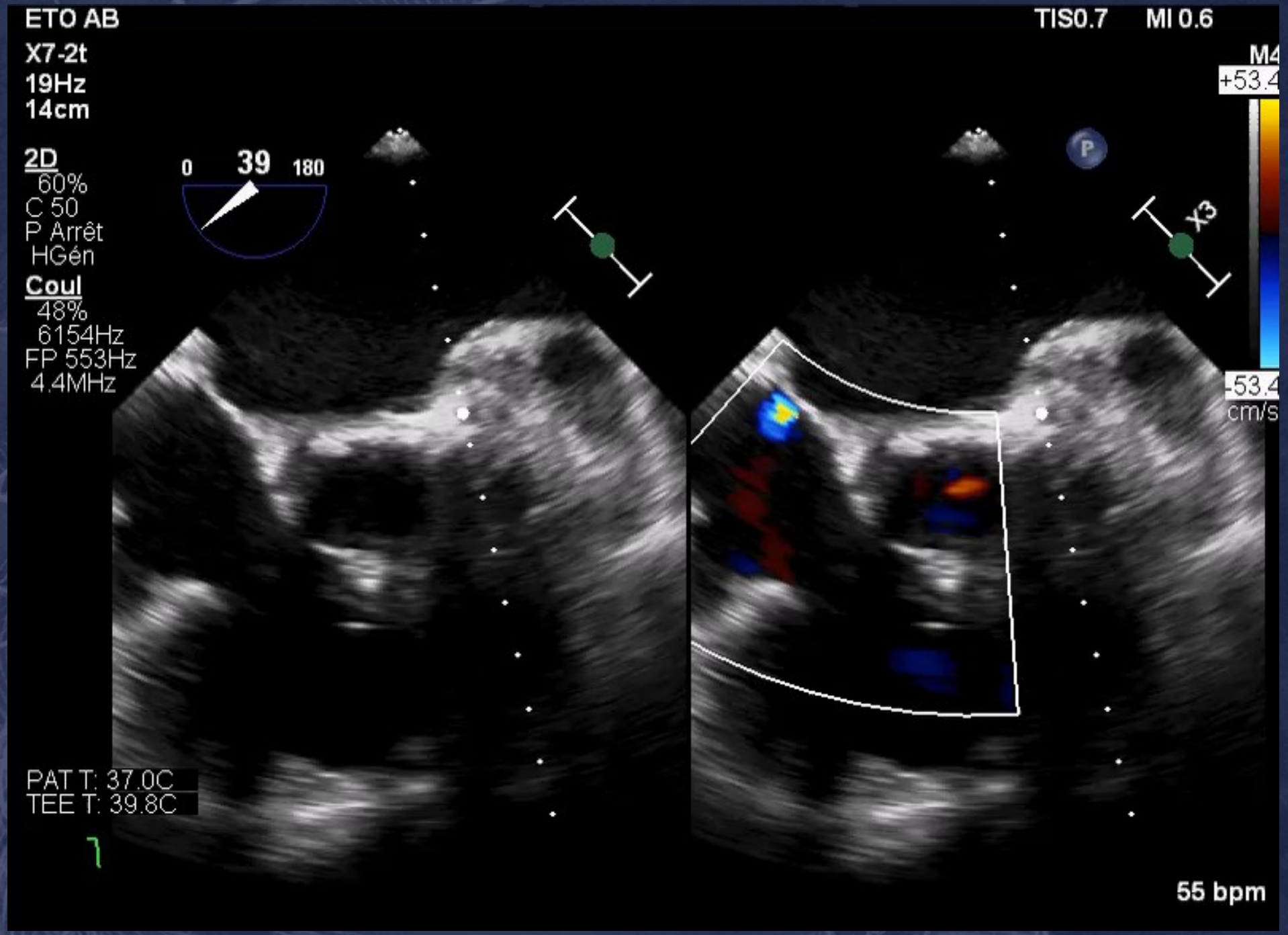

CI 21Hz
10cm
2D
71%
C 50
P Arrêt
Gén
Coul
59%
4.4MHz
FP Haut
Moy
0
110
180
G
P
R
C4 C4
+60.2
-60.2
cm/s
JPEG
*** bpm
T PAT: 37.0C
T ETO: 39.5C

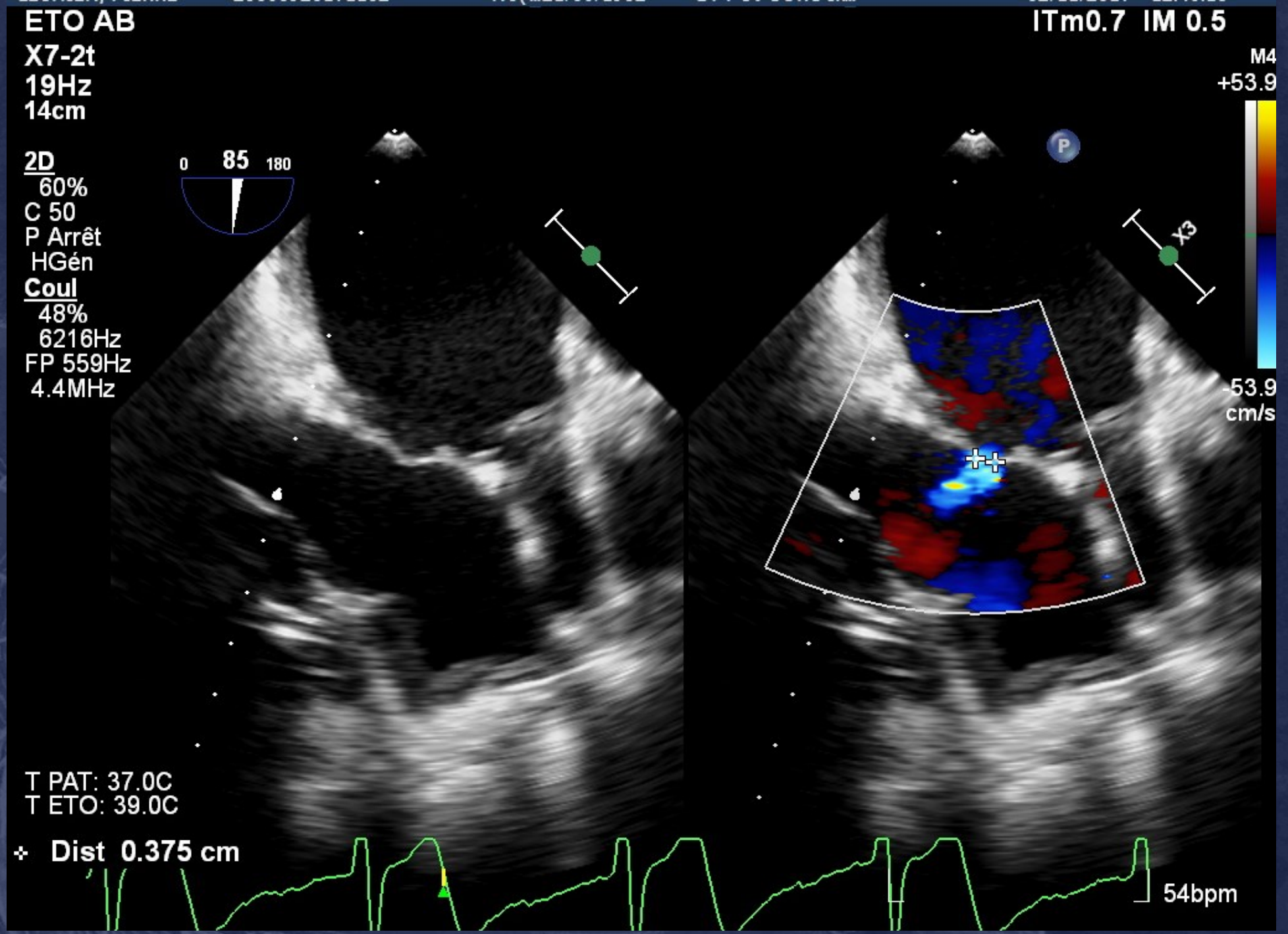

PHILIPS
20/01/2011 15:15:09 ITm0.2 IM 0.5
CX7-2t/Adulte
CI 24Hz
12cm
C4
Volume total 0 45 180
3D 5%
3D 6dB
JPEG
80 bpm
T PAT: 37.0C
T ETO: 39.1C

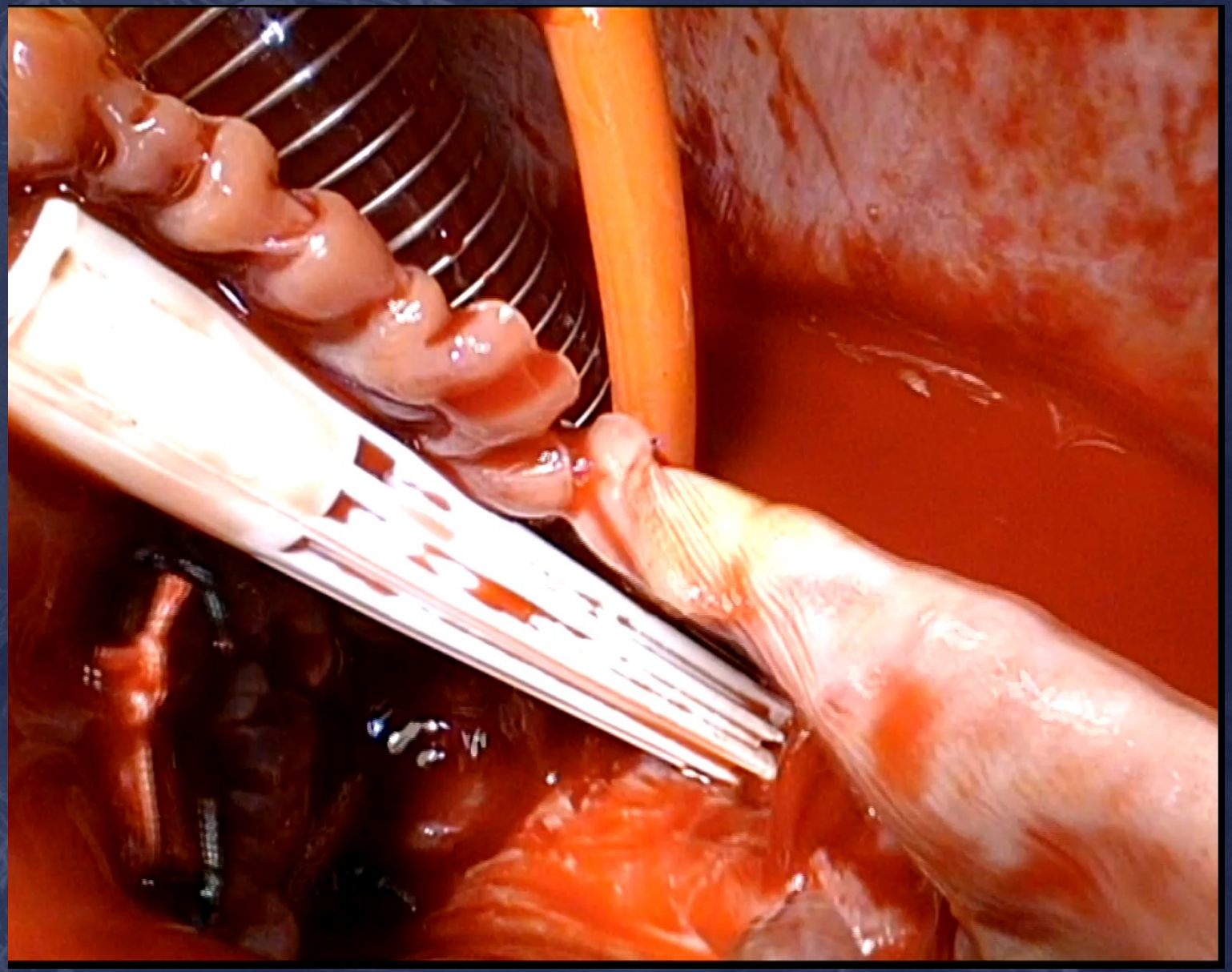

00311520071203
X7-2t/ECHO
CI 10Hz
9.2cm
C4
3D Live
3D 19%
3D 40dB
Gén
0
70
180
JPEG
*** bpm
T PAT: 37.0C
T ETO: 40.0C

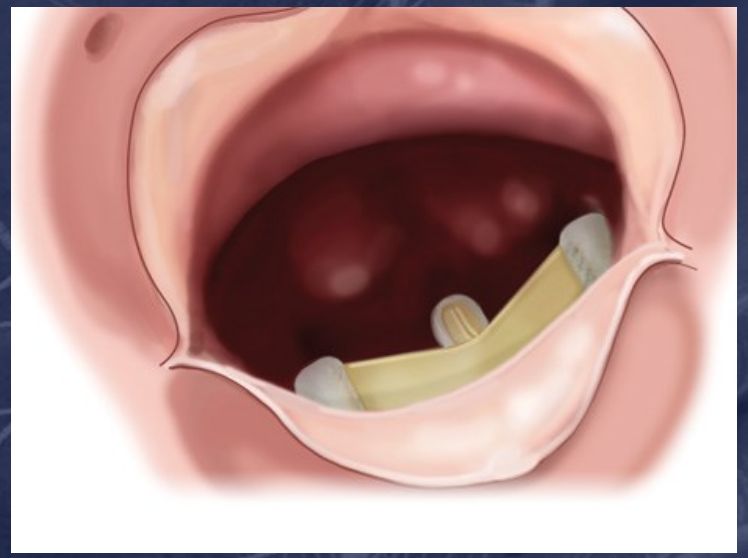
Circumflex injury

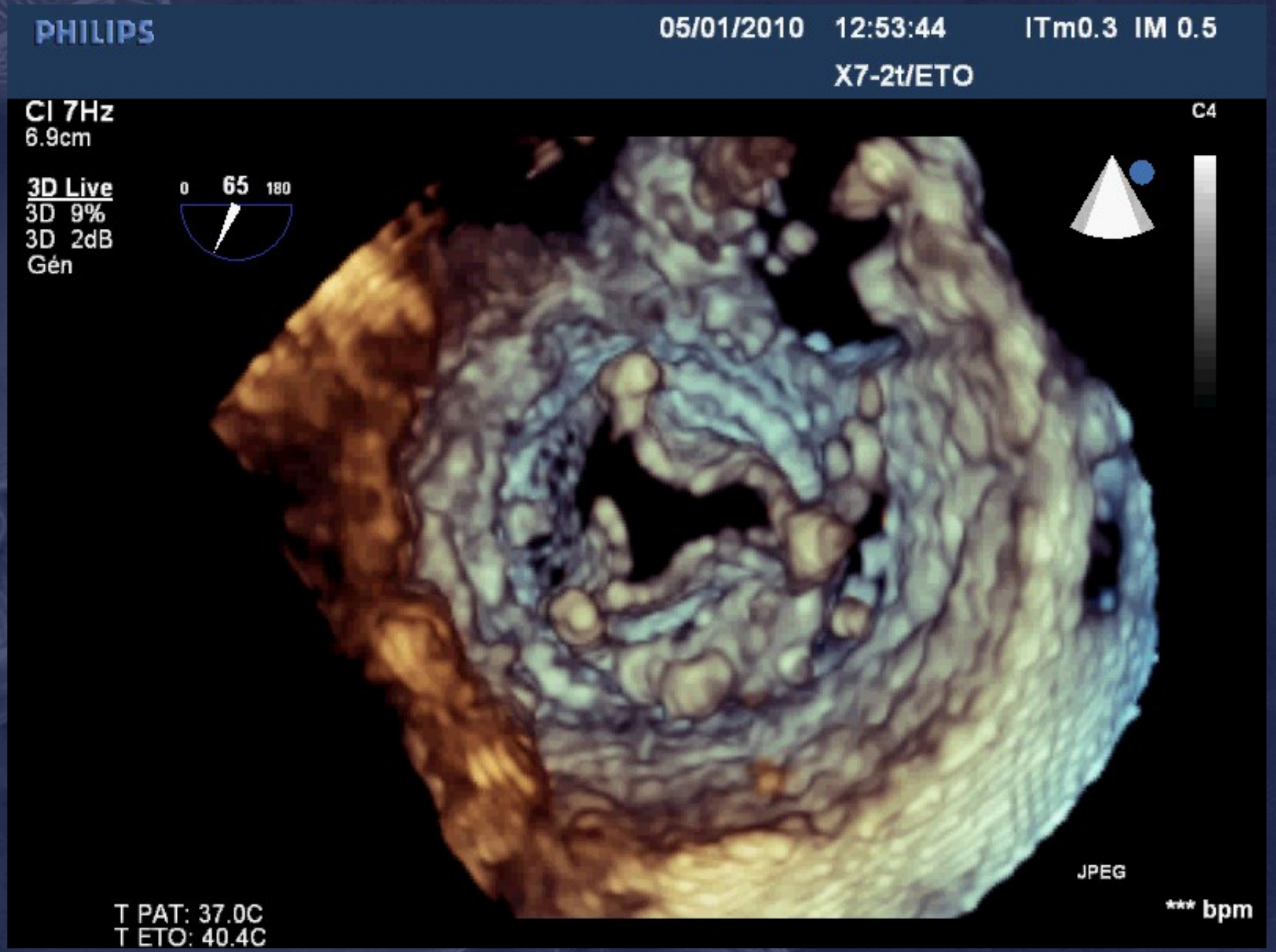



ETO AB
X7-2t
19Hz
14cm
2D
60%
C 50
P Arrêt
HGén
Coul
48%
6154Hz
FP 553Hz
4.4MHz
0
39
180
TIS0.7
MI 0.6
M4
+53.4
-53.4
cm/s
X3
P
PAT T: 37.0C
TEE T: 39.8C
55 bpm


ETO AB
X7-2t
19Hz
14cm
2D
60%
C 50
P Arrêt
HGén
Coul
48%
6216Hz
FP 559Hz
4.4MHz
0
85
180
ITm0.7 IM 0.5
M4
+53.9
-53.9
cm/s
X3
T PAT: 37.0C
T ETO: 39.0C
Dist 0.375 cm
54bpm






PHILIPS
05/01/2010 12:53:44
ITm0.3 IM 0.5
X7-2t/ETO
CI 7Hz
6.9cm
C4
3D Live
3D 9%
3D 2dB
Gén
0 65 180
JPEG
*** bpm
T PAT: 37.0C
T ETO: 40.4C


CI 34Hz
14cm
Battem. 3D 6Q
C4
3D
3D 49%
3D 23dB
0
60
180
JPEG
80 bpm
T PAT: 37.0C
T ETO: 38.8C

REVIEW

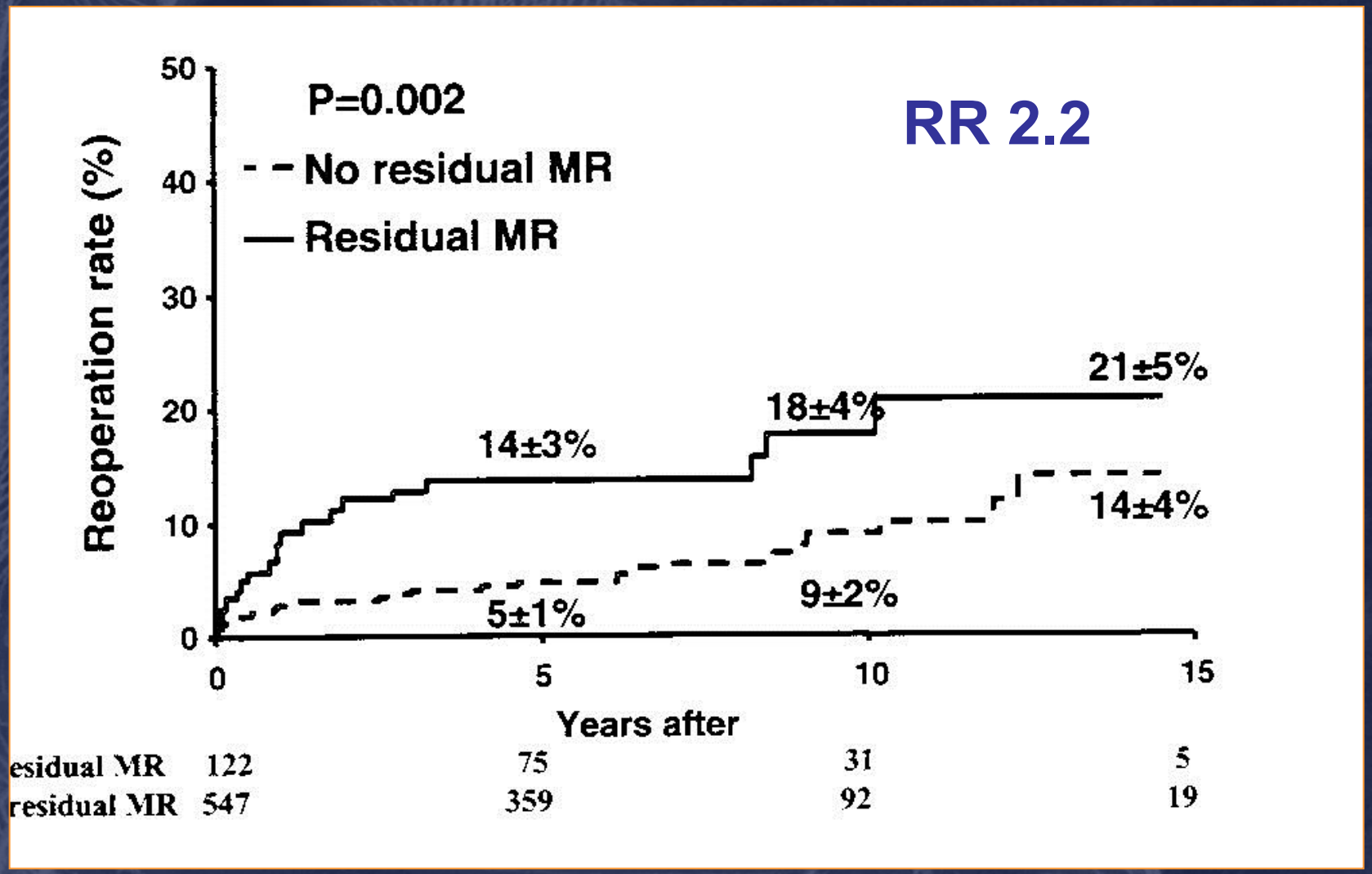
Intraoperative Echocardiography in Valvular Heart Disease: An Evidence-Based Appraisal

Hector I. Michelena, MD; Martin D. Abel, MD; Rakesh M. Suri, MD, PhD; William K. Freeman, MD; Roger L. Click, MD, PhD; Thoralf M. Sundt, MD; Hartzell V. Schaff, MD; and Maurice Enriquez-Sarano, MD

7% second pump run in a meta-analysis of IOE in mitral repair

Mayo Clin Proc. 2010;85(7):646-655

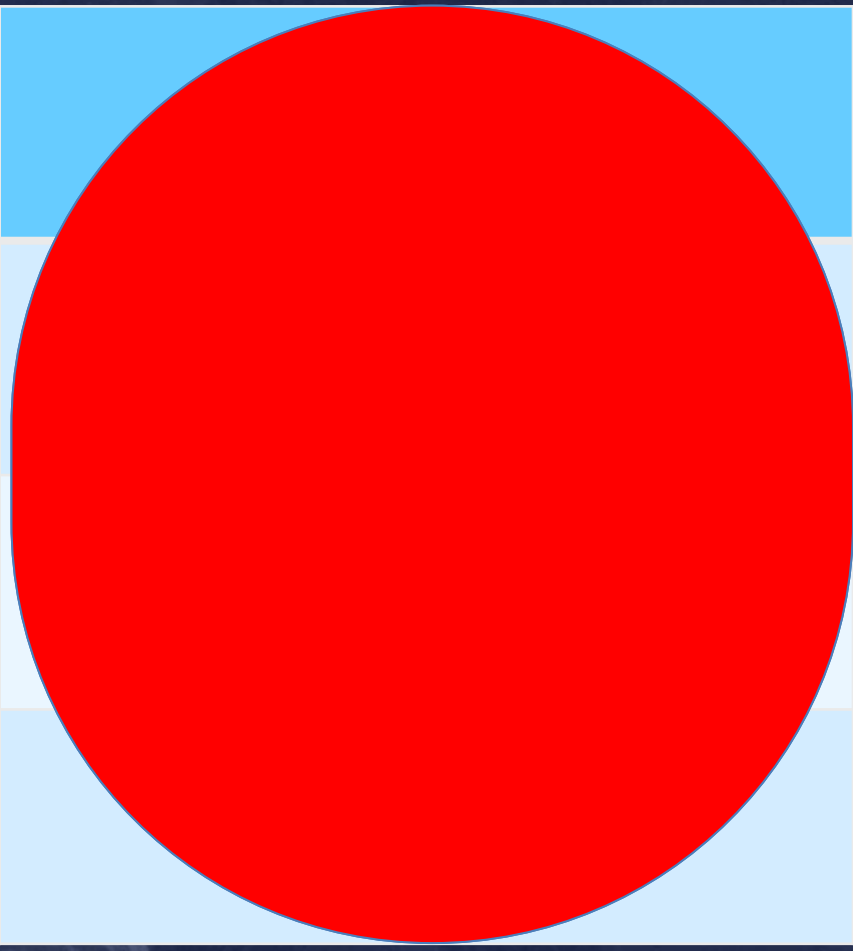
IOE and Reoperation



Mohty et al. Circulation.2001;104:I1-I7

Interventional 2D/3D echocardiography

	Surgical repair	
Valve Analysis	+++	
Positioning	No	
Control	+++	



Indications for intervention in severe primary mitral regurgitation *(continued)*

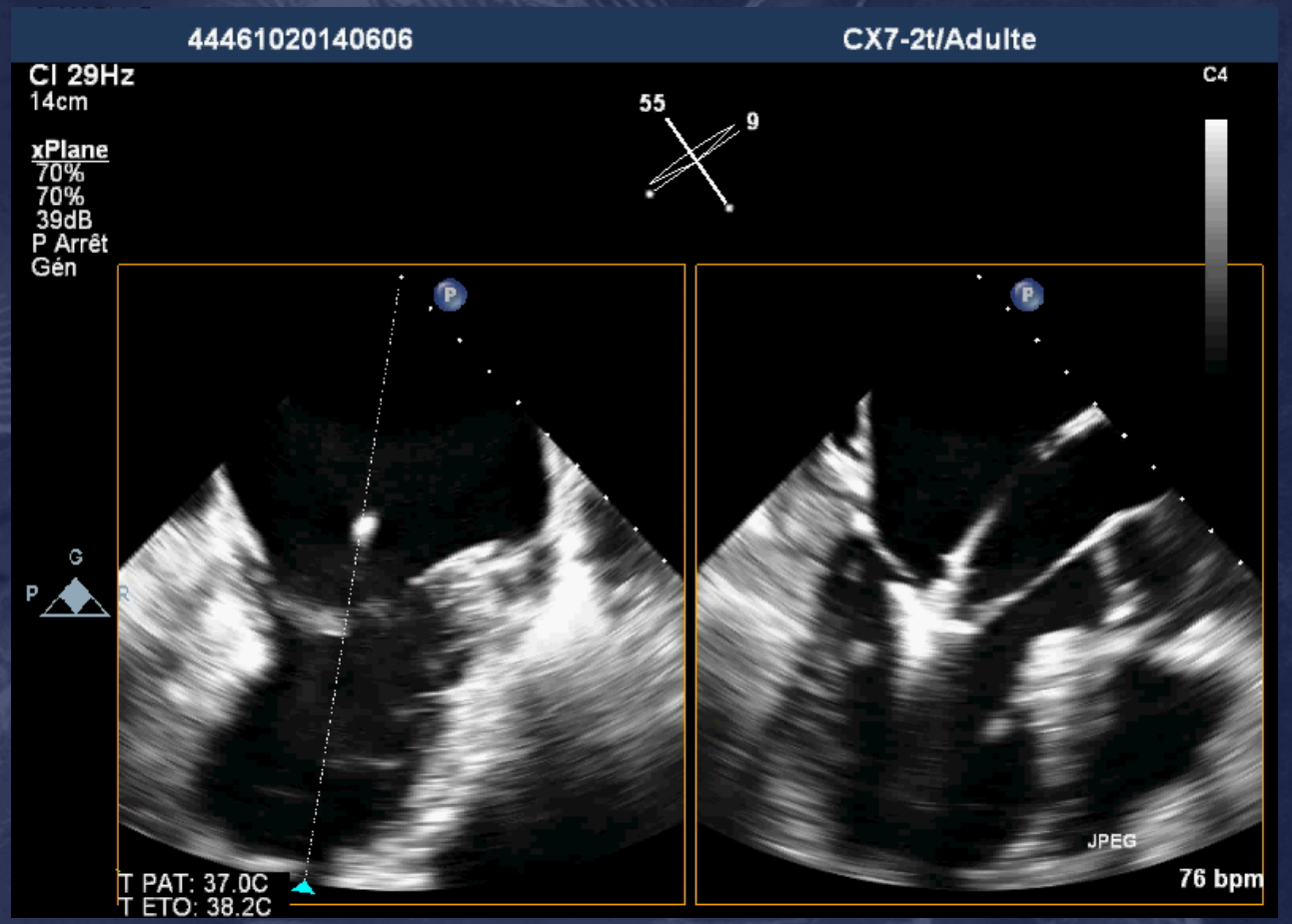
Recommendations	Class	Level
Mitral valve replacement may be considered in symptomatic patients with severe LV dysfunction (LVEF <30% and/or LVESD >55 mm) refractory to medical therapy when likelihood of successful repair is low and comorbidity low.	IIb	C
[redacted]	IIb	C

Eur Heart J. 2017;38:2739–91

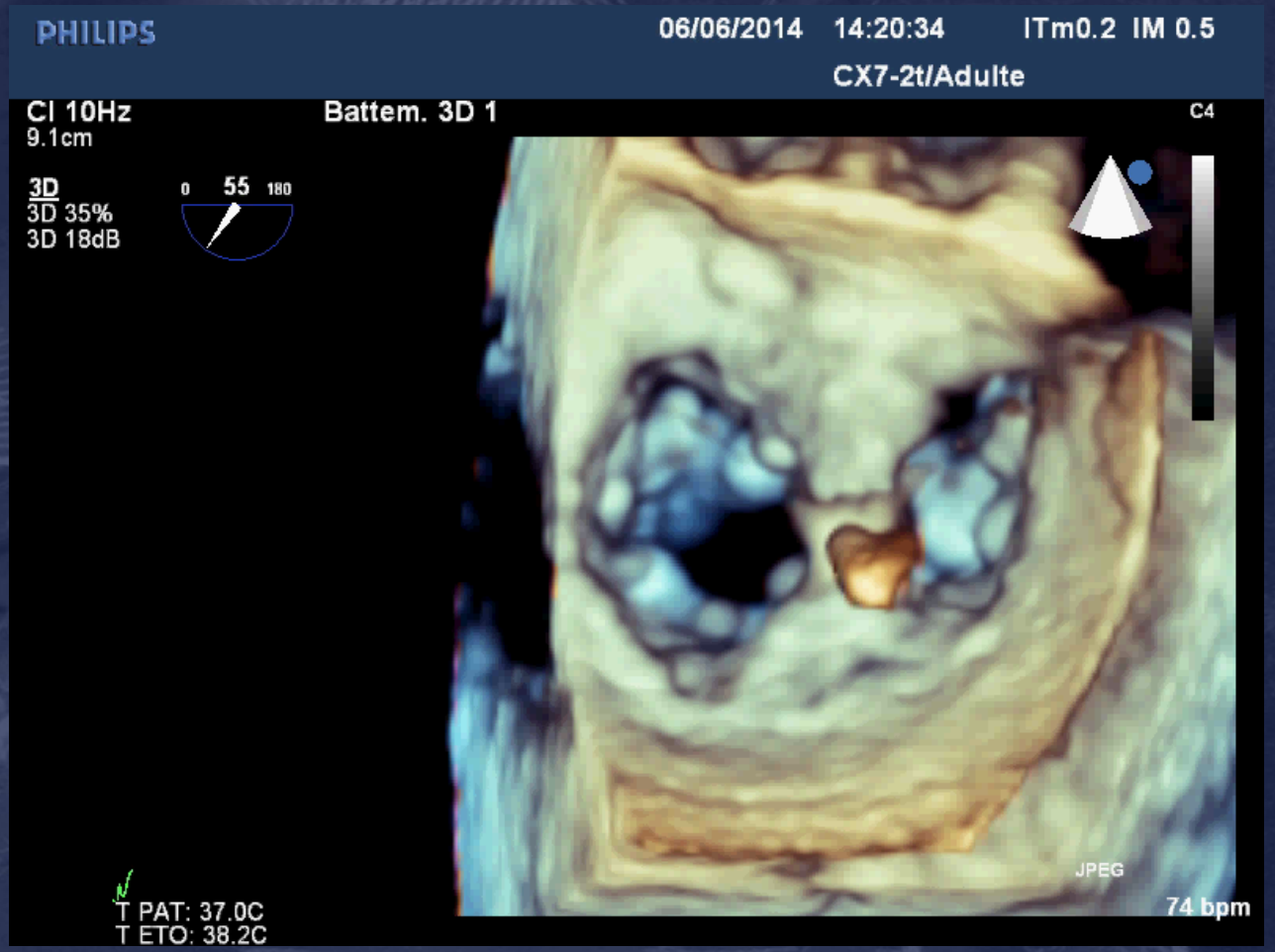
TABLE 4 Favorable Morphological Characterization for Procedural Success Using the MitraClip

MR originating from the midportion of the MV (due to either degenerative or functional etiology)
Nonrheumatic or endocarditic MV disease
Absence of calcification in the grasping area
MV area ≥4 cm^2
PML length ≥10 mm (7 mm)
Flail dimensions: width ≤15 mm, gap ≤10 mm
Sufficient leaflet tissue for coaptation (≥2 mm)
Coaptation depth <11 mm

(J Am Coll Cardiol Img 2018;11:872-901)

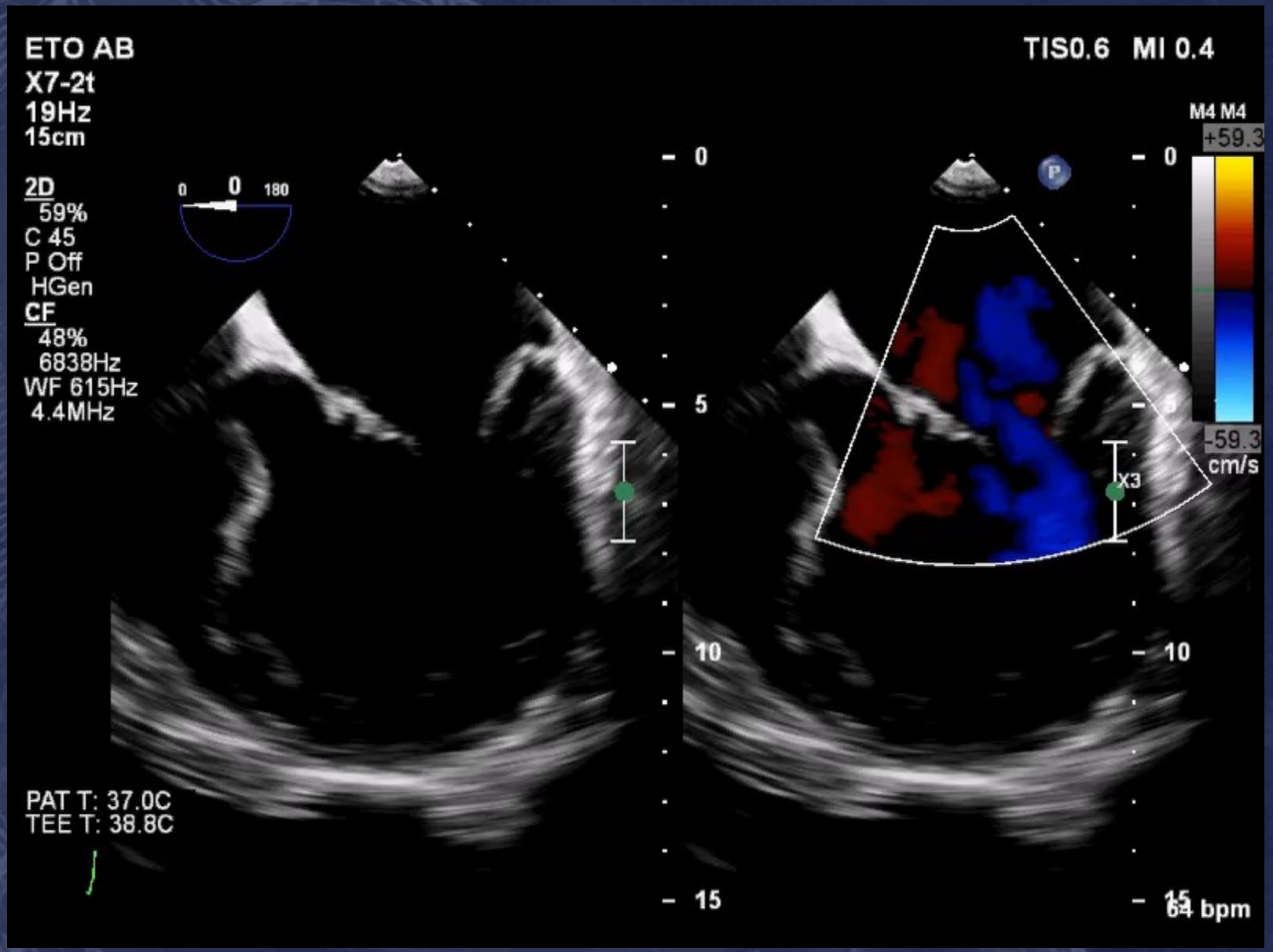

44461020140606
CX7-2t/Adulte
CI 29Hz
14cm
xPlane
70%
70%
39dB
P Arrêt
Gén
55
9
C4
G
P
R
T PAT: 37.0C
T ETO: 38.2C
JPEG
76 bpm

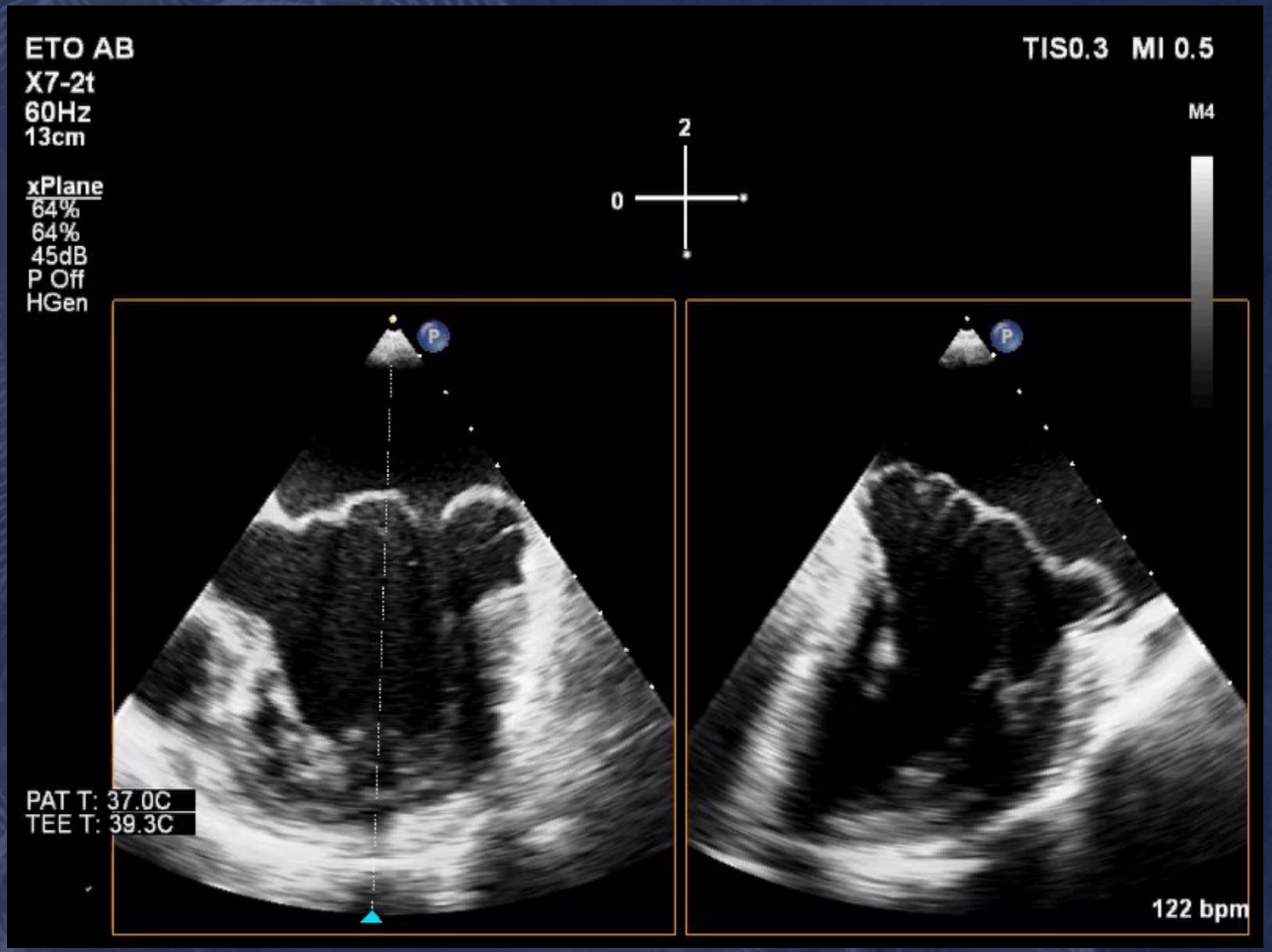
Clip positioning

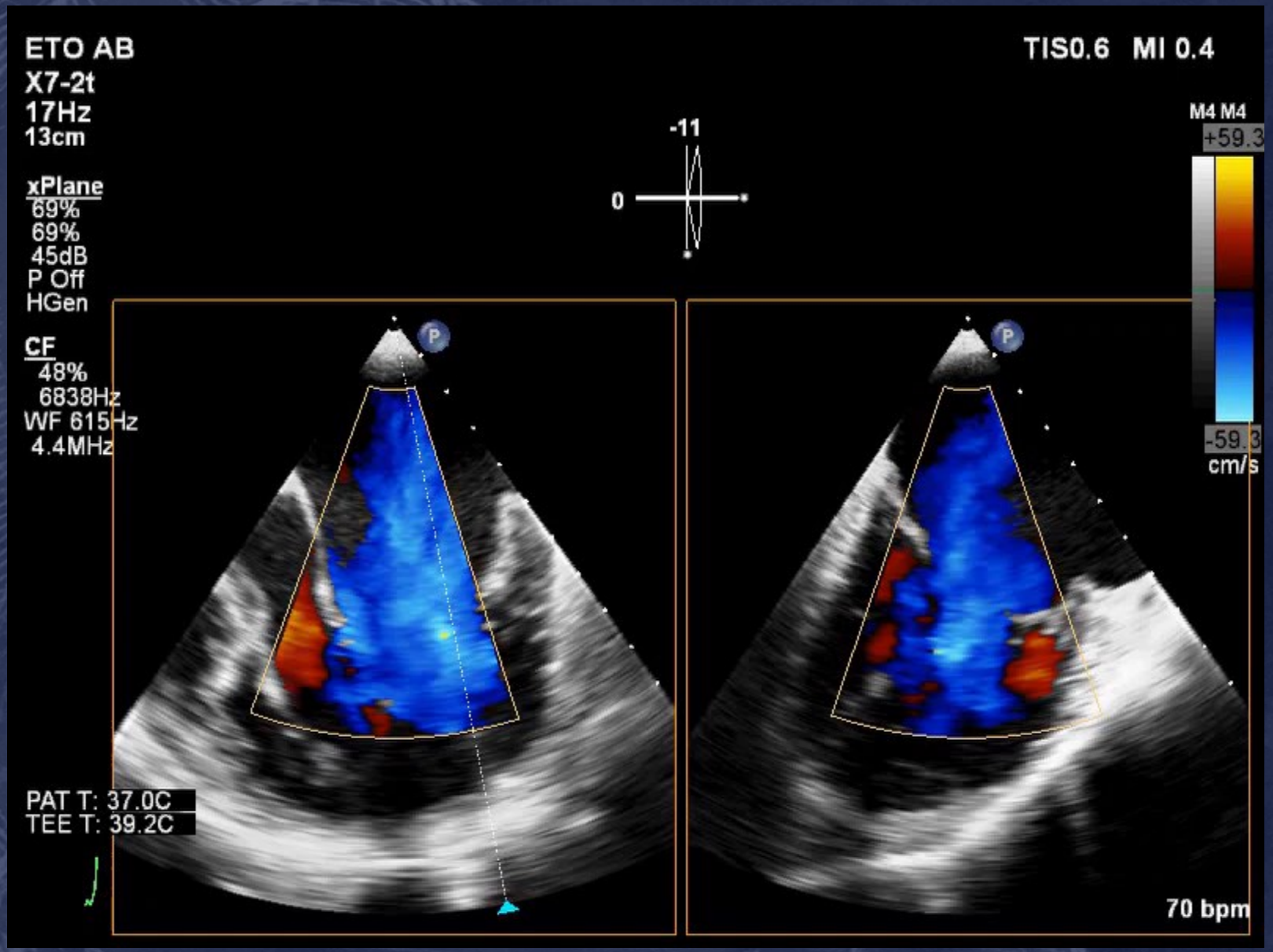

PHILIPS
06/06/2014 14:20:34 ITm0.2 IM 0.5
CX7-2t/Adulte
CI 10Hz
9.1cm
Battem. 3D 1
C4
3D
3D 35%
3D 18dB
0 55 180
JPEG
74 bpm
T PAT: 37.0C
T ETO: 38.2C

IOE and Valve Reconstruction

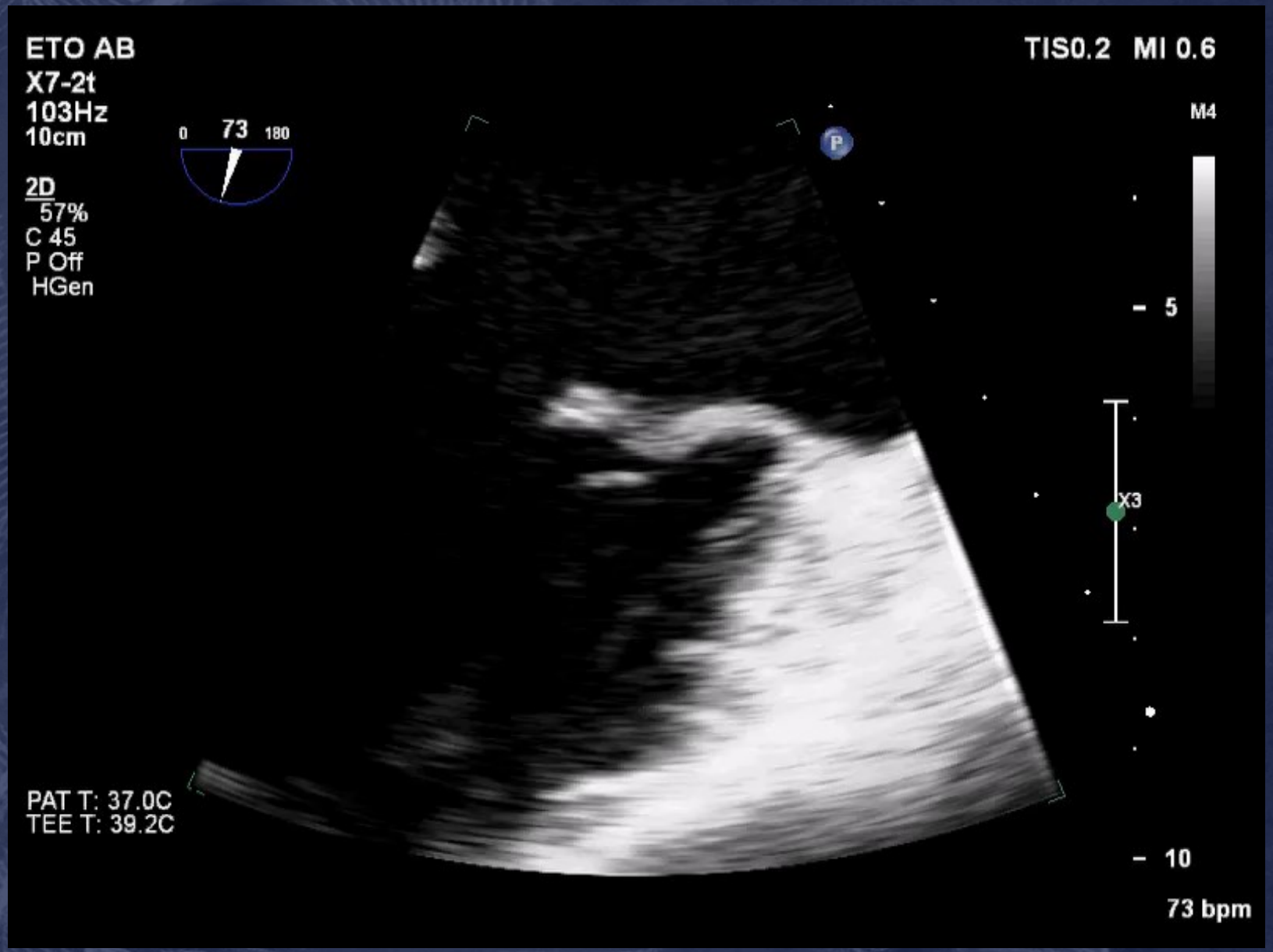
- ✓ Pre-pump: a road map
- ✓ Post pump: a safety net
- ✓ Barlow: new approach


ETO AB
X7-2t
19Hz
15cm
2D
59%
C 45
P Off
HGen
CF
48%
6838Hz
WF 615Hz
4.4MHz
PAT T: 37.0C
TEE T: 38.8C
TIS0.6 MI 0.4
M4 M4
+59.3
-59.3
cm/s
X3
0
5
10
15
64 bpm

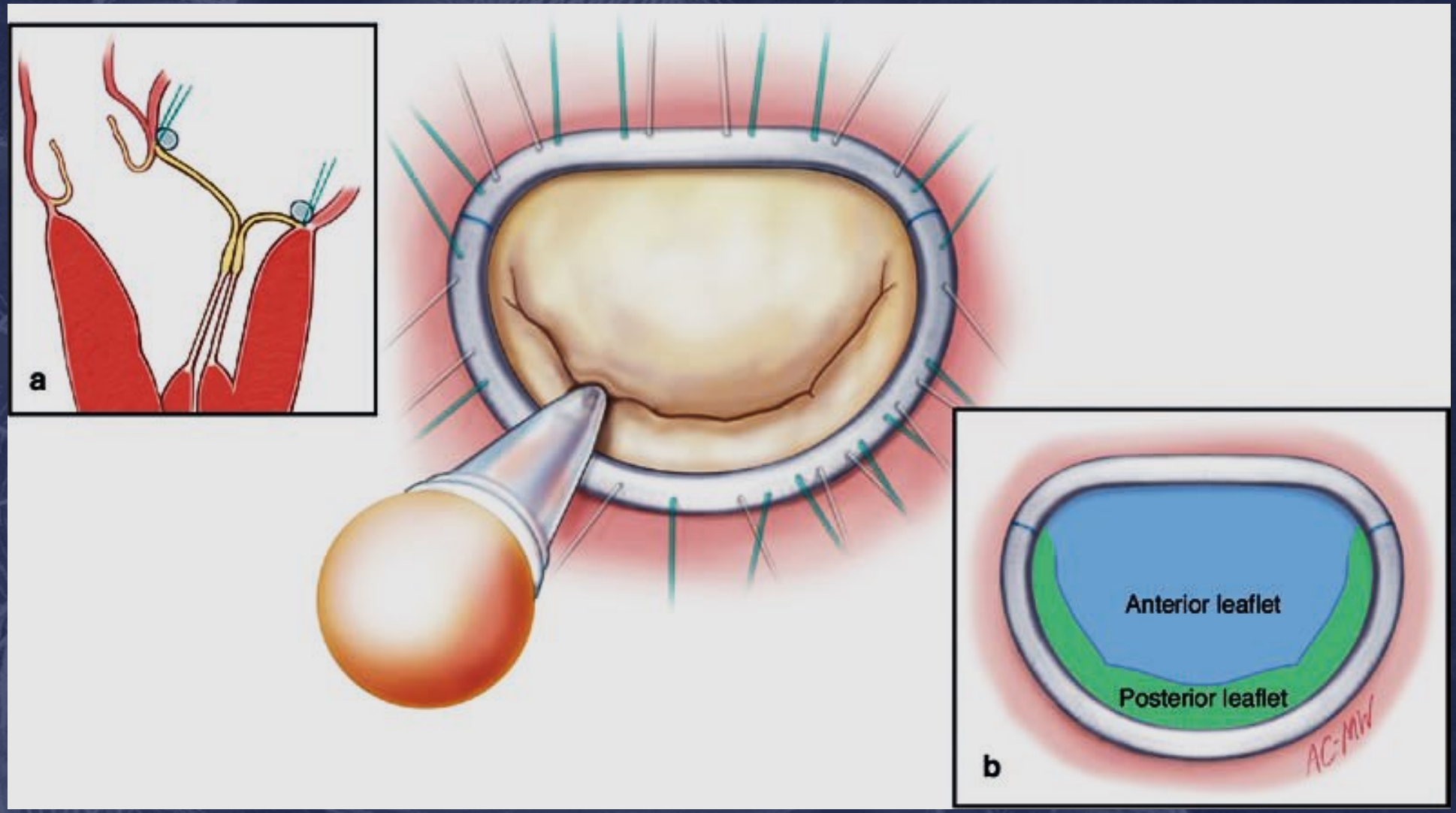

ETO AB
X7-2t
60Hz
13cm
xPlane
64%
64%
45dB
P Off
HGen
TIS0.3 MI 0.5
M4
2
0
PAT T: 37.0C
TEE T: 39.3C
122 bpm

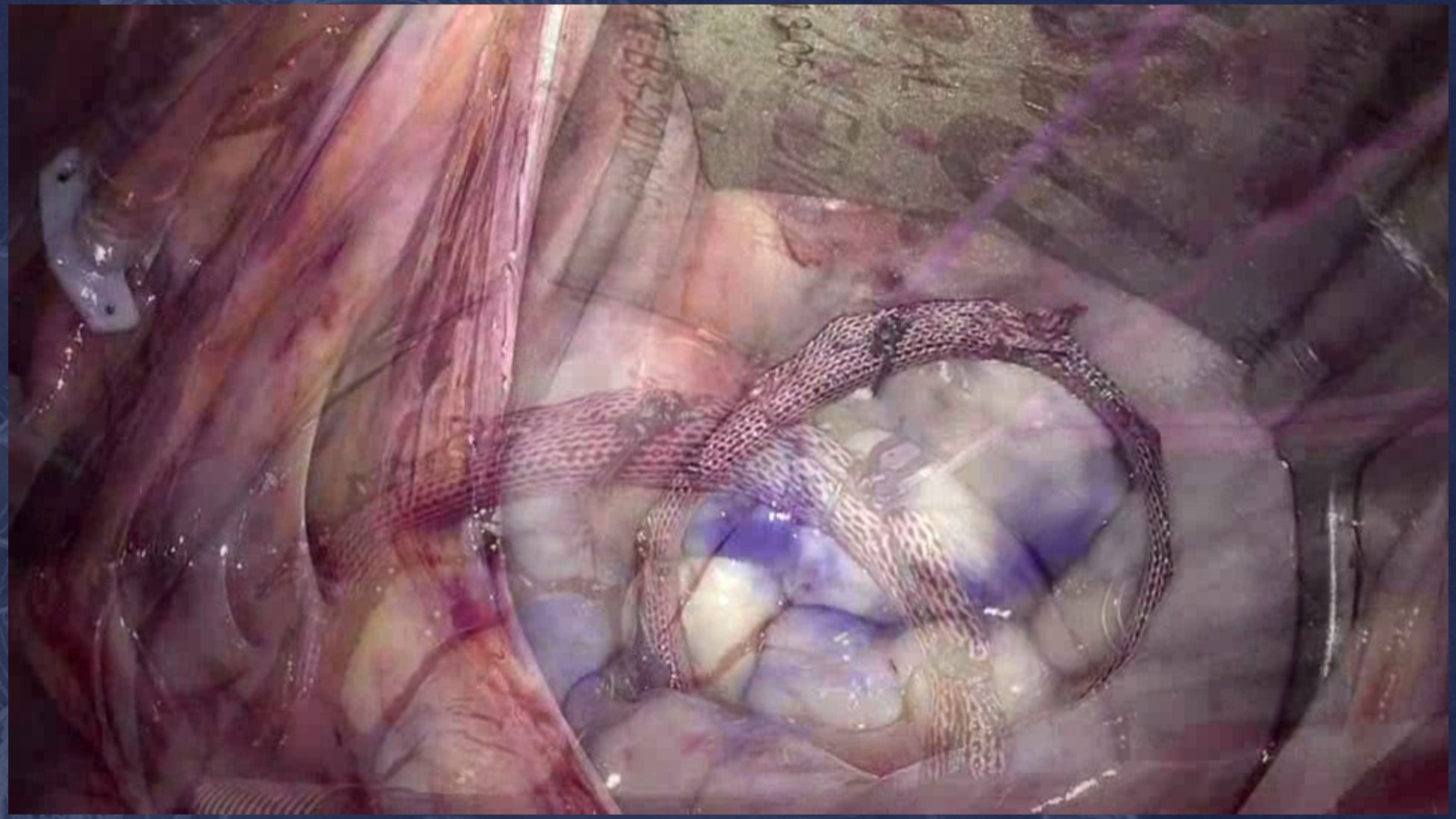

ETO AB
X7-2t
17Hz
13cm
xPlane
69%
69%
45dB
P Off
HGen
CF
48%
6838Hz
WF 615Hz
4.4MHz
PAT T: 37.0C
TEE T: 39.2C
TIS0.6 MI 0.4
-11
0
M4 M4
+59.3
-59.3
cm/s
70 bpm

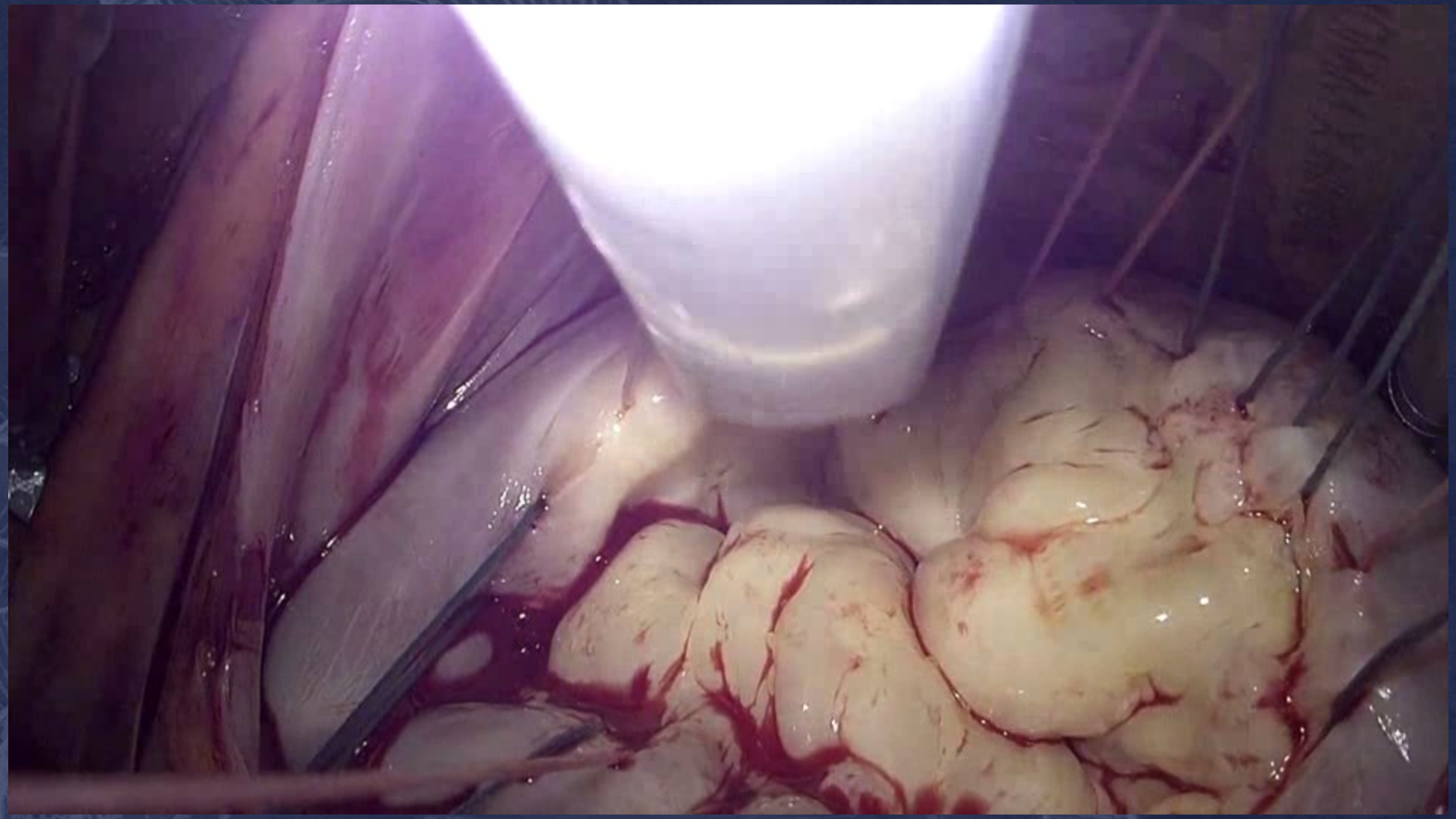
Mitral Annular Disjunction

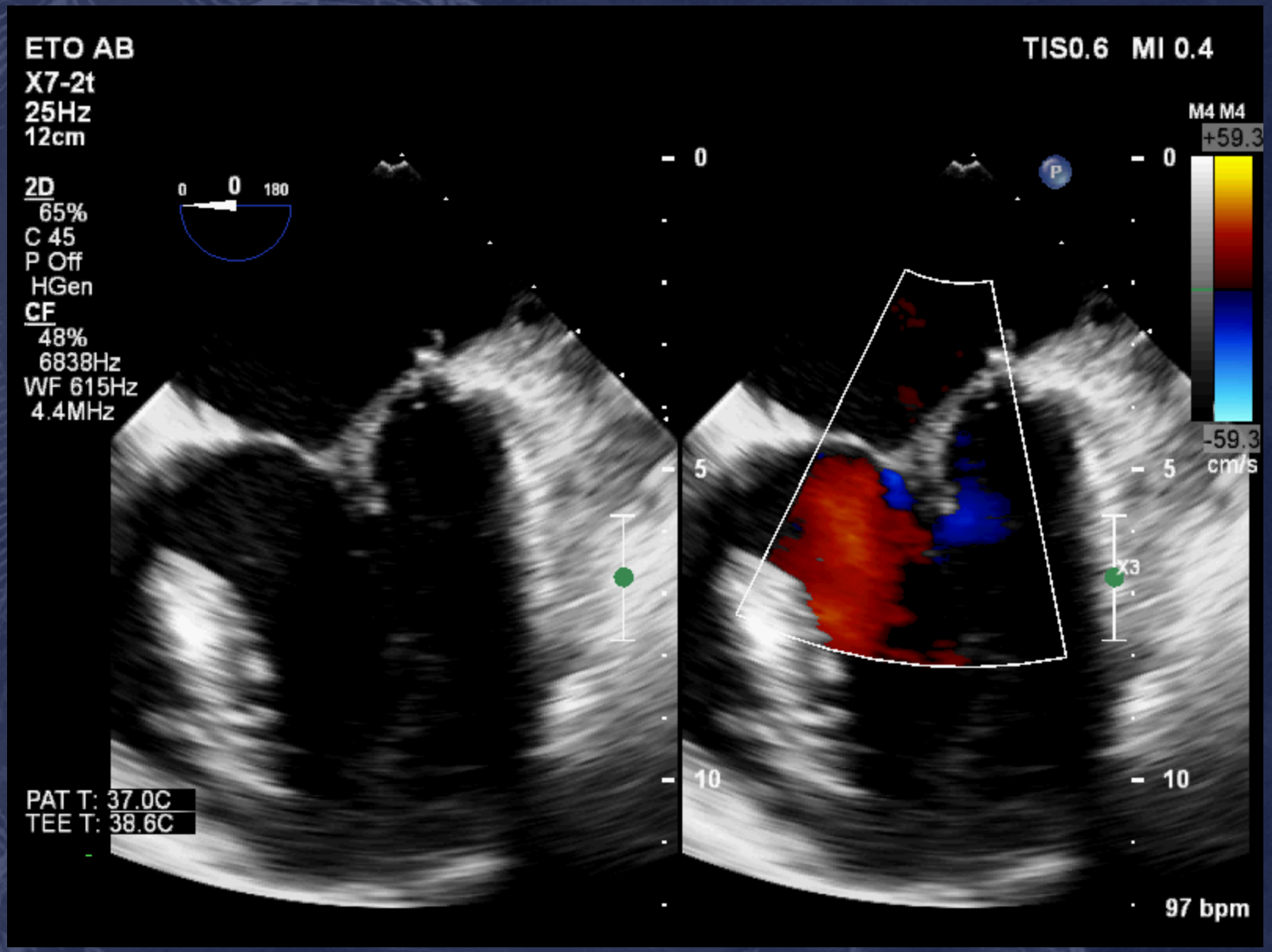


Isolated annuloplasty large ring

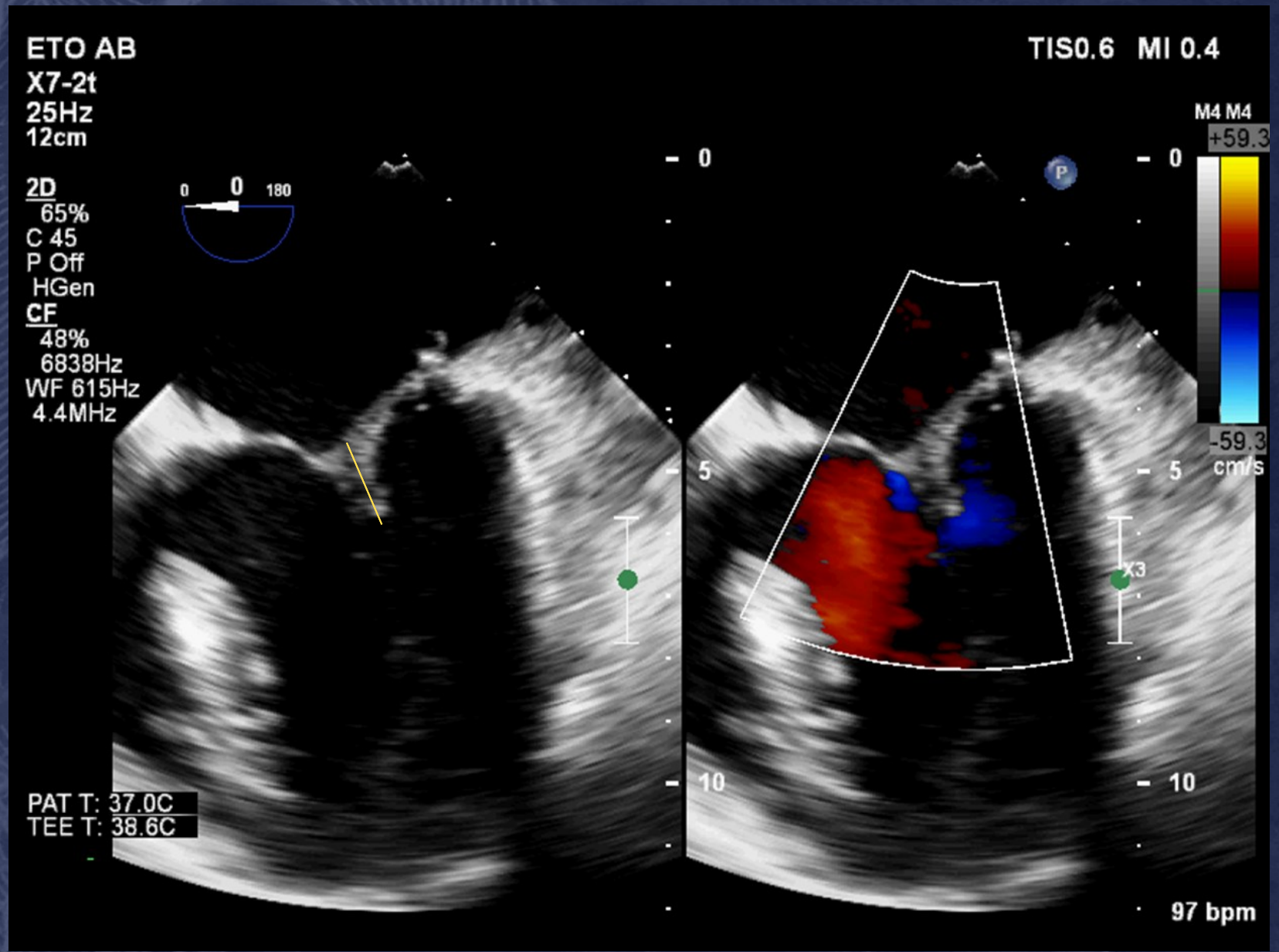







ETO AB
X7-2t
25Hz
12cm
2D
65%
C 45
P Off
HGen
CF
48%
6838Hz
WF 615Hz
4.4MHz
TIS0.6 MI 0.4
M4 M4
+59.3
-59.3
cm/s
0
180
0
5
10
X3
PAT T: 37.0C
TEE T: 38.6C
97 bpm

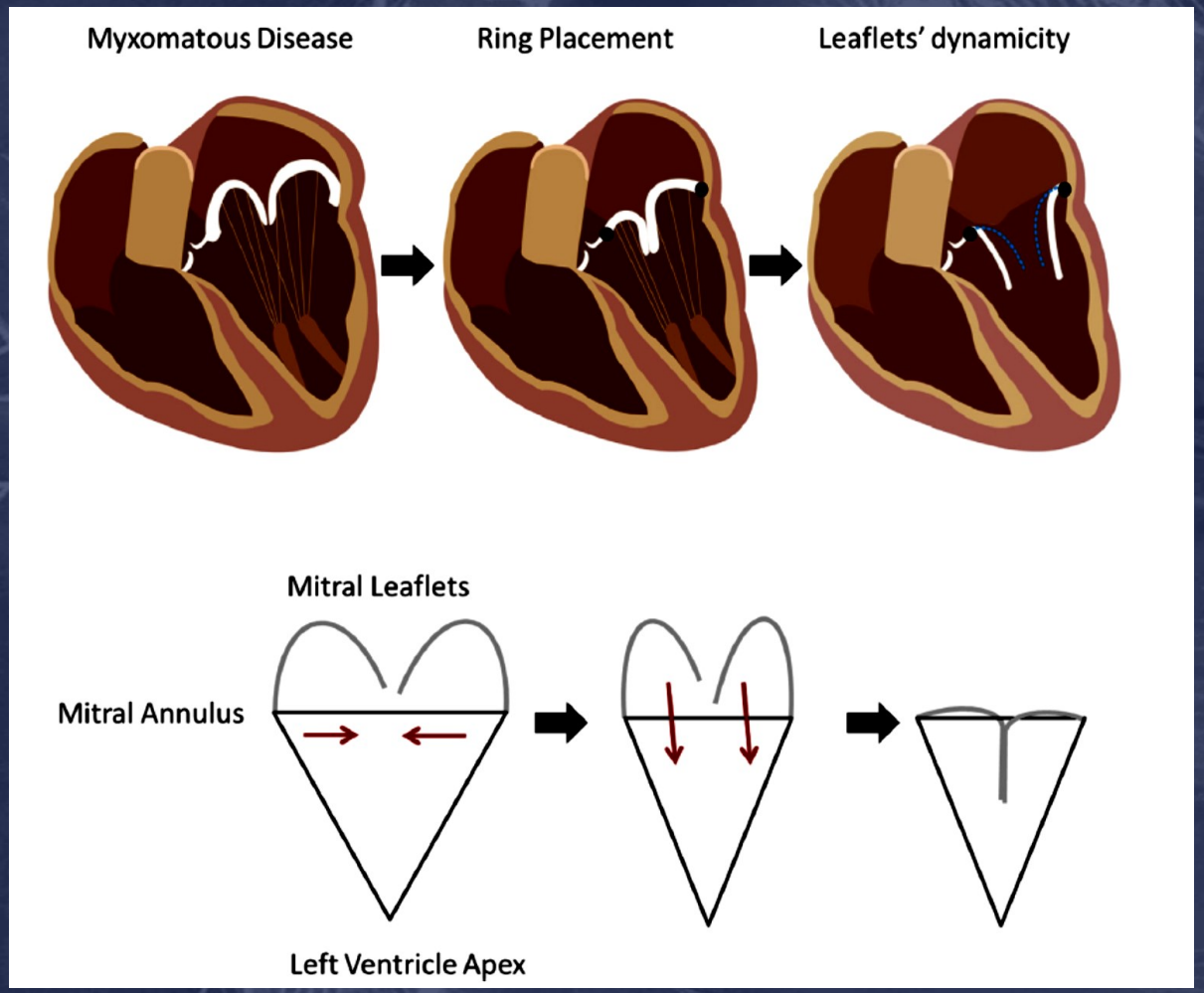
Good coaptation and no billowing

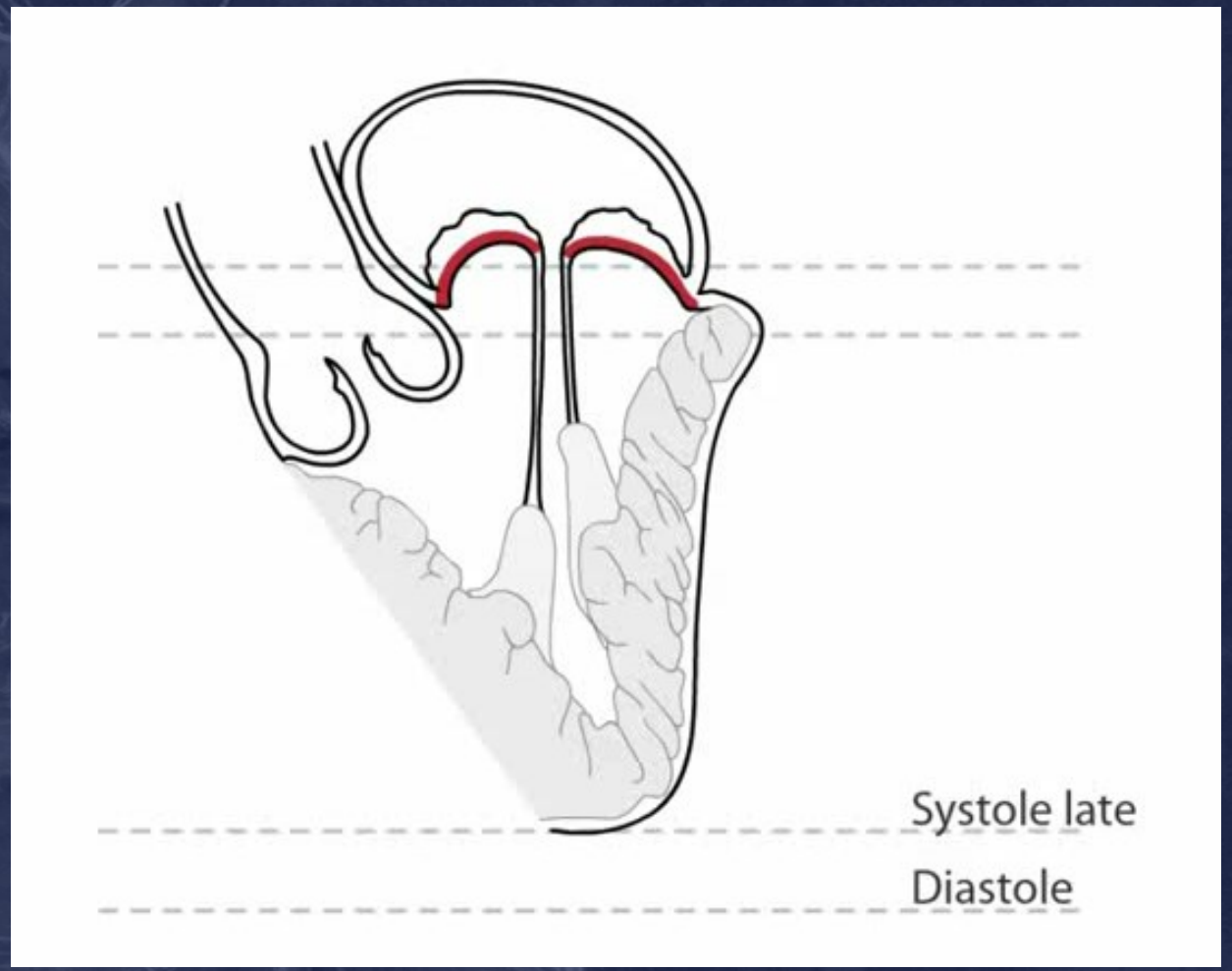


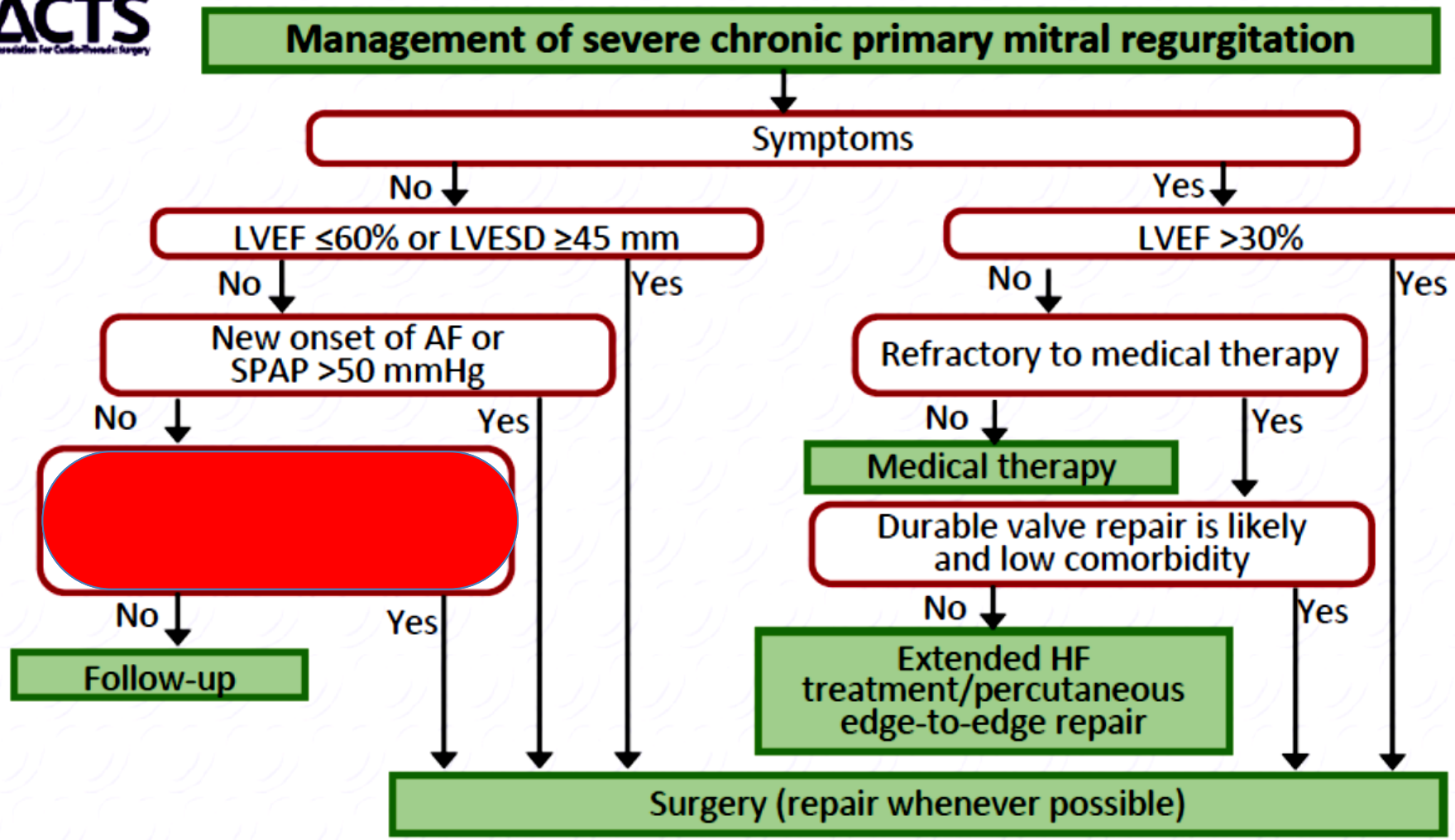
Simple repair approach for mitral regurgitation in Barlow disease

Sagit Ben Zekry, MD,[a,c] Dan Spiegelstein, MD,[b,c] Leonid Sternik, MD,[b,c] Innon Lev, MD,[b,c]
Alexander Kogan, MD,[b,c] Rafael Kuperstein, MD,[a,c] and Ehud Raanani, MD[b,c]

(J Thorac Cardiovasc Surg 2015;150:1071-7)





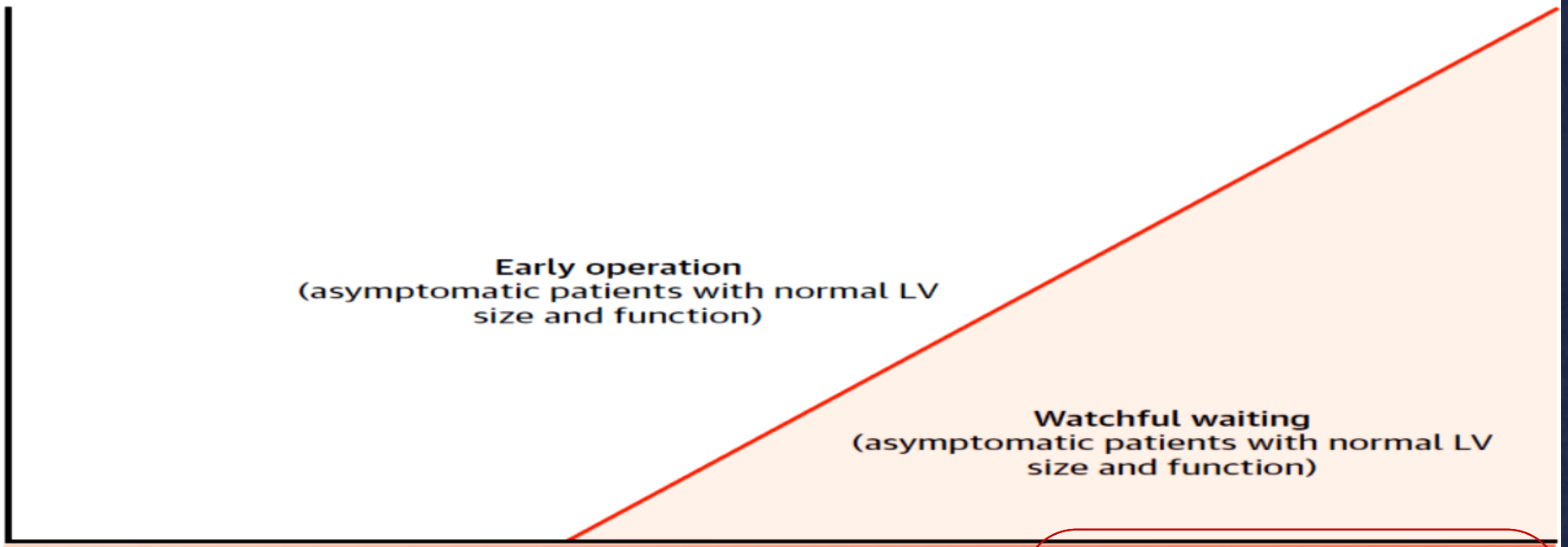


[a] *LVESD ≥40 mm and one of the following present: flail leaflet or LA volume ≥60 mL/m² BSA at sinus rhythm*

Eur Heart J. 2017;38:2739–91

Mitral Valve Regurgitation in the Contemporary Era

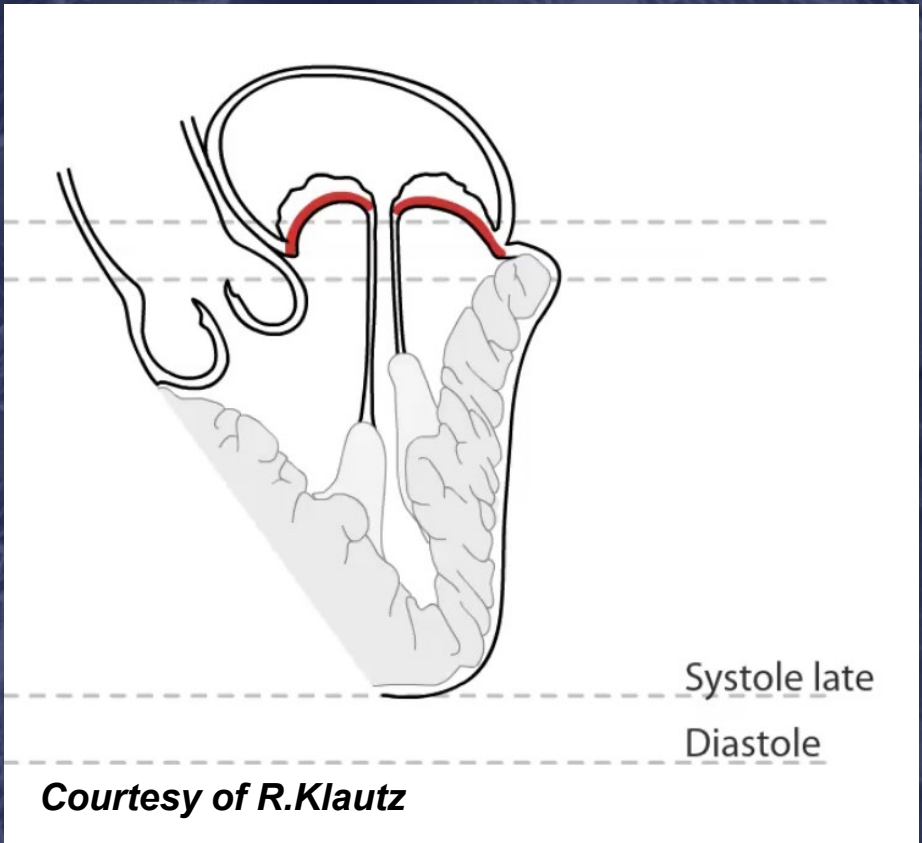
Insights Into Diagnosis, Management, and Future Directions



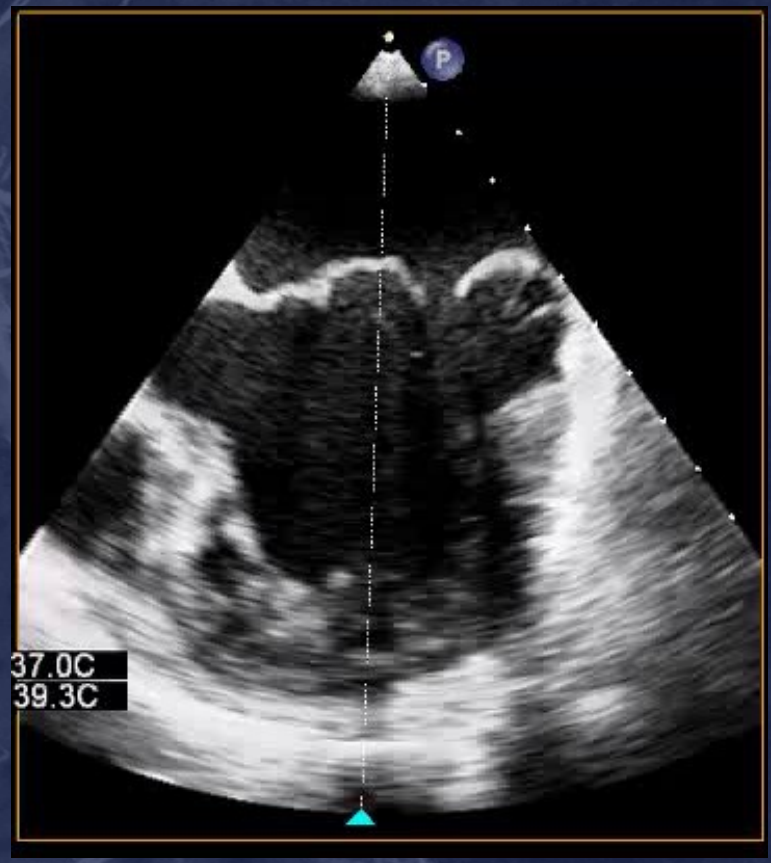
	Repair feasible		Repair Less Likely
Primary MR			
Prolapse Segment	Posterior	Anterior	Bileaflet Severe Barlow
Calcification	None	Mild	Moderate
Annular dilatation	Mild	Moderate	Severe
Other		Perforation, Cleft	Rheumatic

El Sabbagh, A. et al. J Am Coll Cardiol Img. 2018;11(4):628-43.

PM Stretching



Courtesy of R.Klautz



The Mitral Annulus Disjunction Arrhythmic Syndrome

Lars A. Dejgaard, MD,[a,b,c] Eystein T. Skjølsvik, MD,[a,b,c] Øyvind H. Lie, MD,[a,b,c] Margareth Ribe, RN,[a,b] Mathis K. Stokke, MD, PhD,[a,b] Finn Hegbom, MD, PhD,[a,b] Esther S. Scheirlynck, MD,[a,b] Erik Gjertsen, MD,[d] Kristoffer Andresen, MD,[d] Thomas M. Helle-Valle, MD, PhD,[a,b] Einar Hopp, MD, PhD,[a,e] Thor Edvardsen, MD, PhD,[a,b,c,f] Kristina H. Haugaa, MD, PhD[a,b,c,f]

ABSTRACT

BACKGROUND Mitral annulus disjunction (MAD) is an abnormal atrial displacement of the mitral valve leaflet hinge point. MAD has been associated with mitral valve prolapse (MVP) and sudden cardiac death.

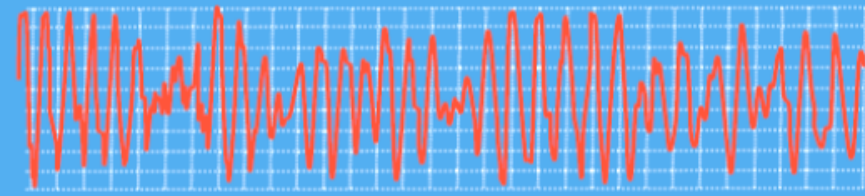
OBJECTIVES The purpose of this study was to describe the clinical presentation, MAD morphology, association with MVP, and ventricular arrhythmias in patients with MAD.

METHODS The authors clinically examined patients with MAD. By echocardiography, the authors assessed the presence of MVP and measured MAD distance in parasternal long axis. Using cardiac magnetic resonance (CMR), the authors assessed circumferential MAD in the annular plane, longitudinal MAD distance, and myocardial fibrosis. Aborted cardiac arrest and sustained ventricular tachycardia were defined as severe arrhythmic events.

RESULTS The authors included 116 patients with MAD (age 49 ± 15 years; 60% female). Palpitations were the most

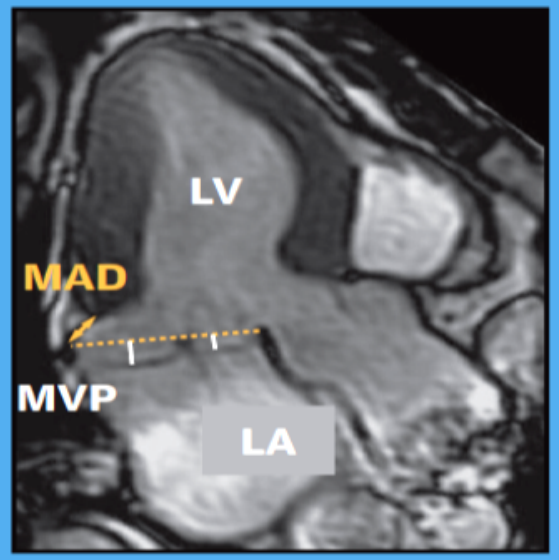
Patients with severe arrhythmic events were younger (age 37 ± 13 years vs. 51 ± 14 years; p = 0.001), had lower ejection fraction (51 ± 5% vs. 57 ± 7%; p = 0.002) and had more frequently papillary muscle fibrosis (4 [36%] vs. 6 [9%]; p = 0.03). MVP was evident in 90 (78%) patients and was not associated with ventricular arrhythmia.

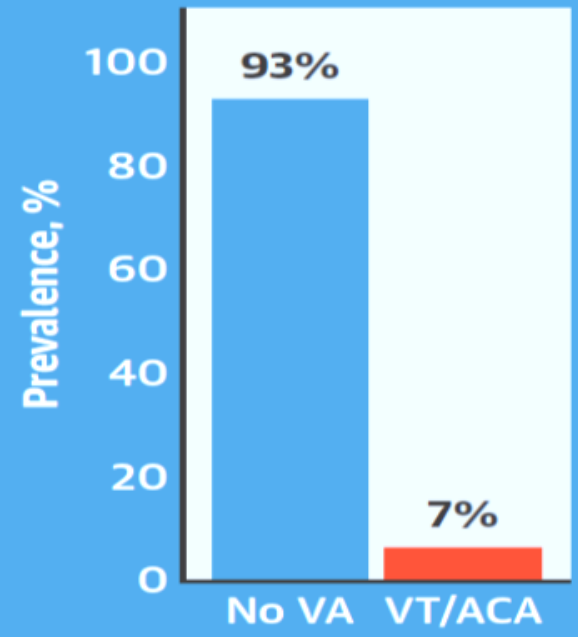
116 Patients with Mitral Annulus Disjunction (MAD)



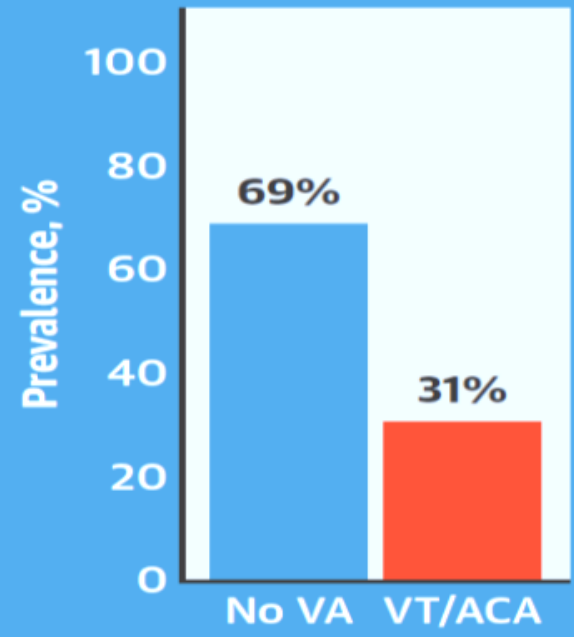
14 with aborted cardiac arrest or sustained ventricular tachycardia

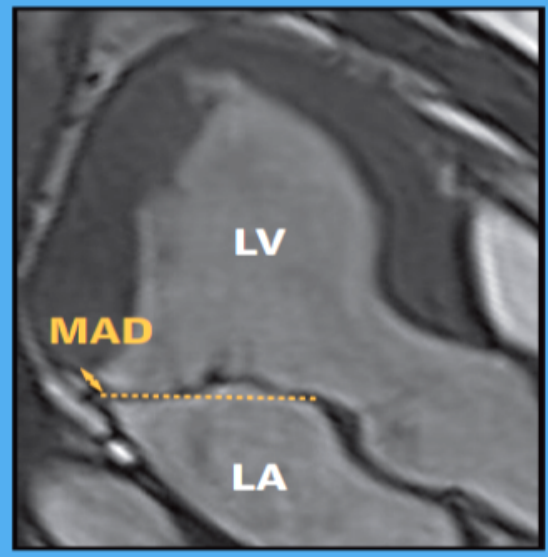
90 MAD *with* Mitral Valve Prolapse



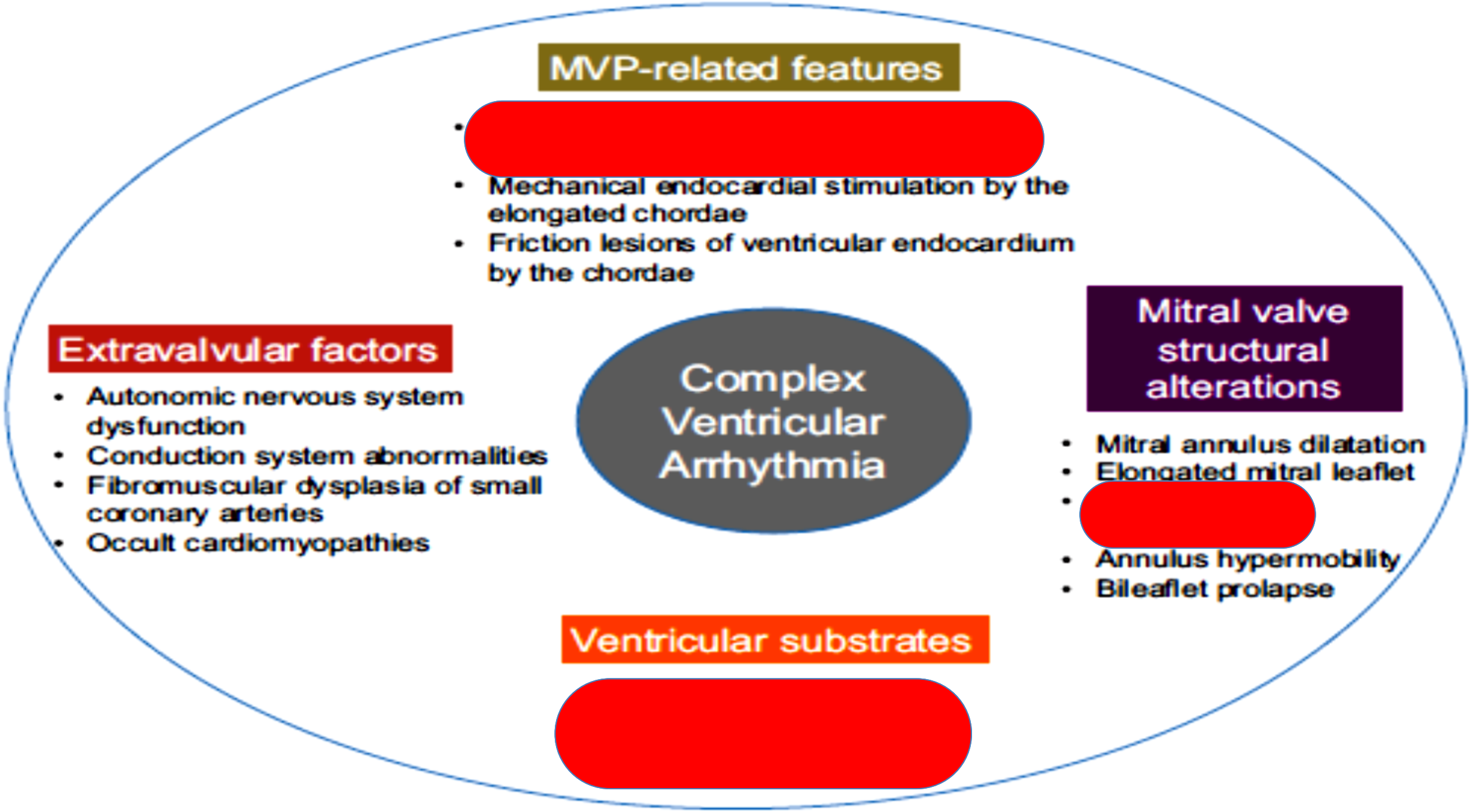


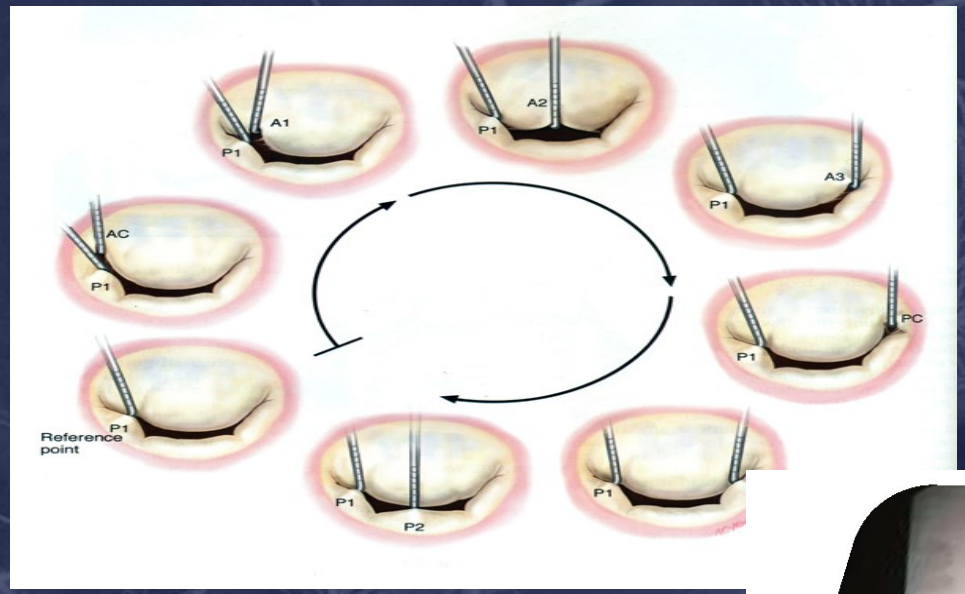
26 MAD *without* Mitral Valve Prolapse

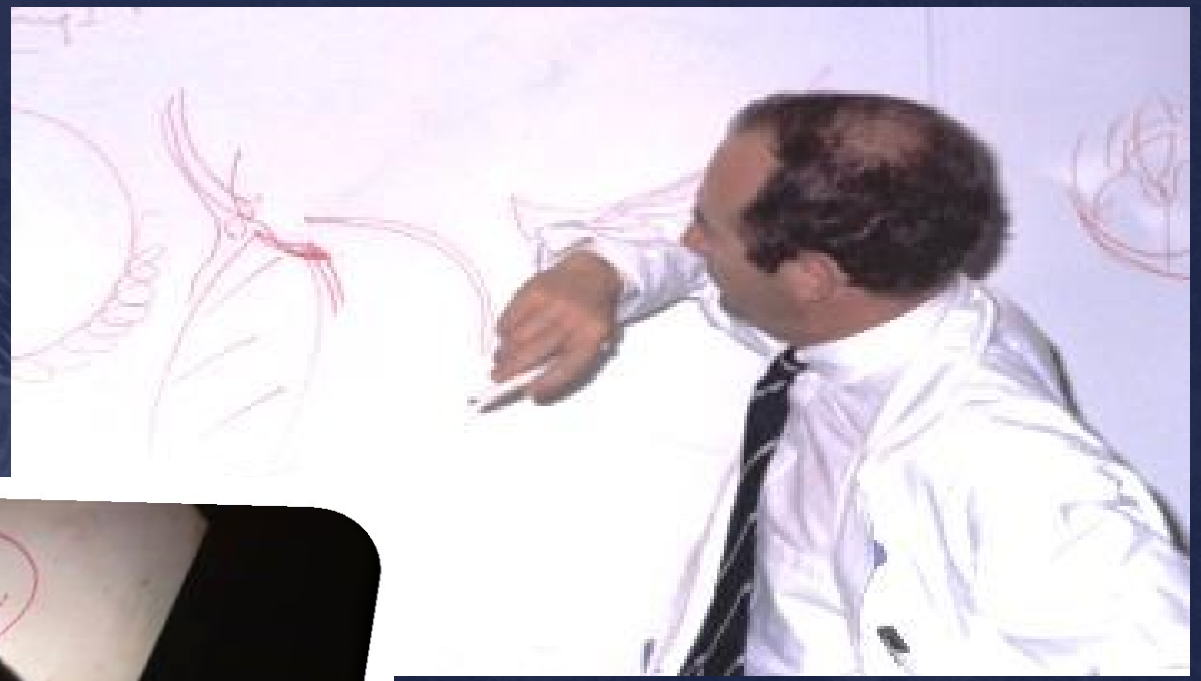


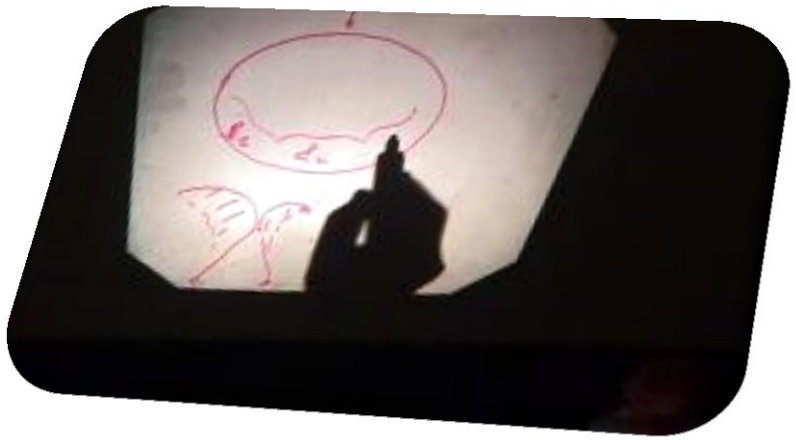


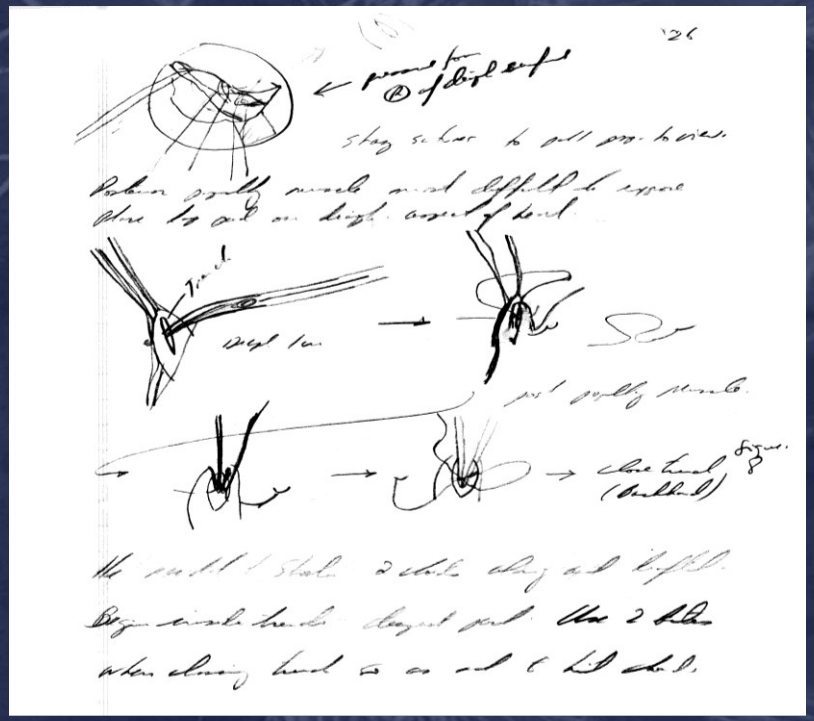
Dejgaard, L.A. et al. J Am Coll Cardiol. 2018;72(14):1600-9.

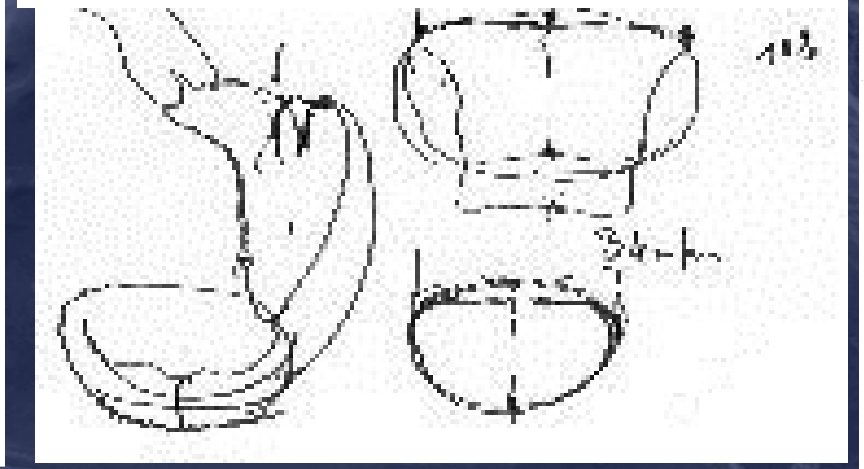

MVP-related features
[redacted]
Mechanical endocardial stimulation by the elongated chordae
Friction lesions of ventricular endocardium by the chordae
Extravalvular factors
Autonomic nervous system dysfunction
Conduction system abnormalities
Fibromuscular dysplasia of small coronary arteries
Occult cardiomyopathies
Complex Ventricular Arrhythmia
Mitral valve structural alterations
Mitral annulus dilatation
Elongated mitral leaflet
[redacted]
Annulus hypermobility
Bileaflet prolapse
Ventricular substrates
[redacted]

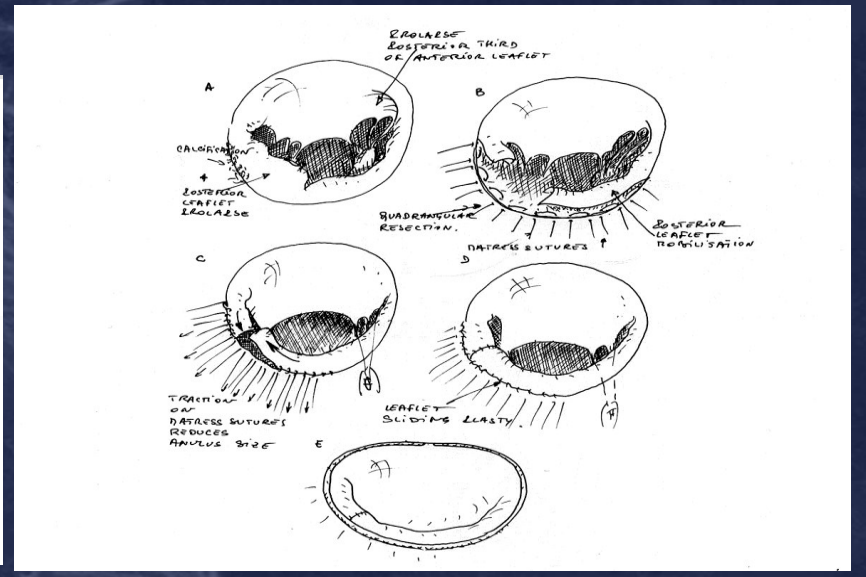

A1
P1
A2
P1
A3
P1
AC
P1
PC
P1
P1
Reference point
P1
P2
P1





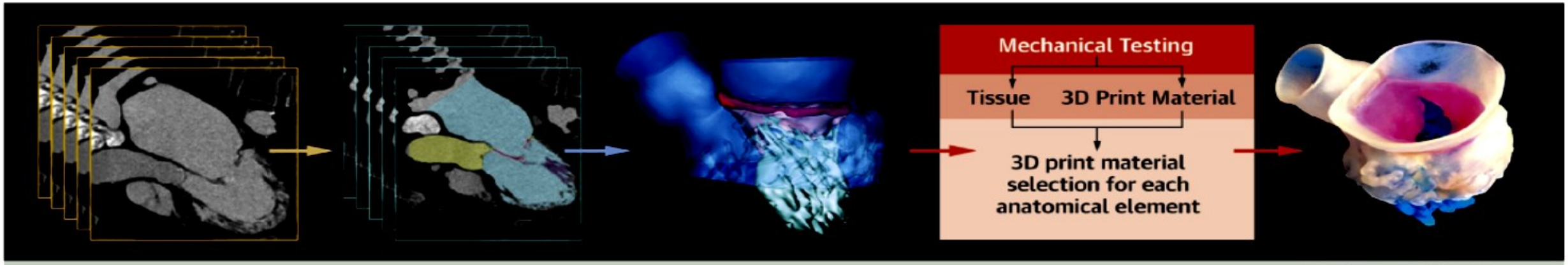





A
B
C
D
E
TRACTION ON DIATRESS SUTURES REDUCES ANNULUS SIZE
LEAFLET SLIDING PLASTY

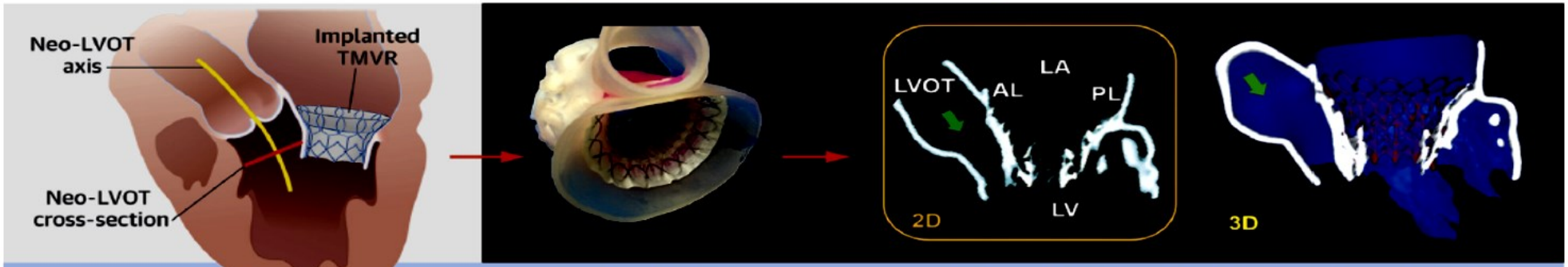
CENTRAL ILLUSTRATION **Creation of a Patient-Specific Multimaterial 3D Model of the Mitral Valve Apparatus**

3D PRINTED MODELING



Imaging Data | Segmentation | Digital Model | Multi-material 3D Printed Model

PROCEDURAL PLANNING



Implanted TMVR | CT Scan of 3D Printed Model with Implanted TMVR

Vukicevic, M. et al. J Am Coll Cardiol Img. 2017;10(2):171–84.

Conclusion

Think reconstruction in a team effort