A 3D echocardiography reconstruction of a heart valve, likely the mitral valve, shown in a semi-transparent orange color. The valve is positioned in the center of the frame, with its leaflets and chordae tendineae visible. The background is a dark blue, semi-transparent volume representing the heart's internal structure. The text "State-of-The-Art 3D Echocardiography for Structural heart Intervention" is overlaid in white on the right side of the image.

# State-of-The-Art 3D Echocardiography for Structural heart Intervention

Prof Alex Lee  
CUHK

How to practically use 3DE  
for structural intervention in  
2020?



3D For The Sake of 2D

```
graph TD; A[3D For The Sake of 2D] --> B[3D For The Sake of 3D]; B --> C[Be Realistic]; C --> D[Be Photo-realistic];
```

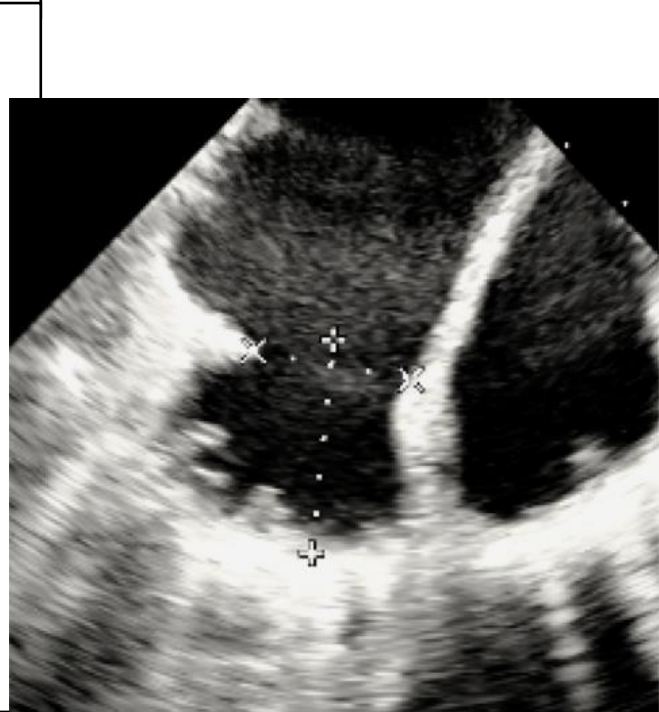
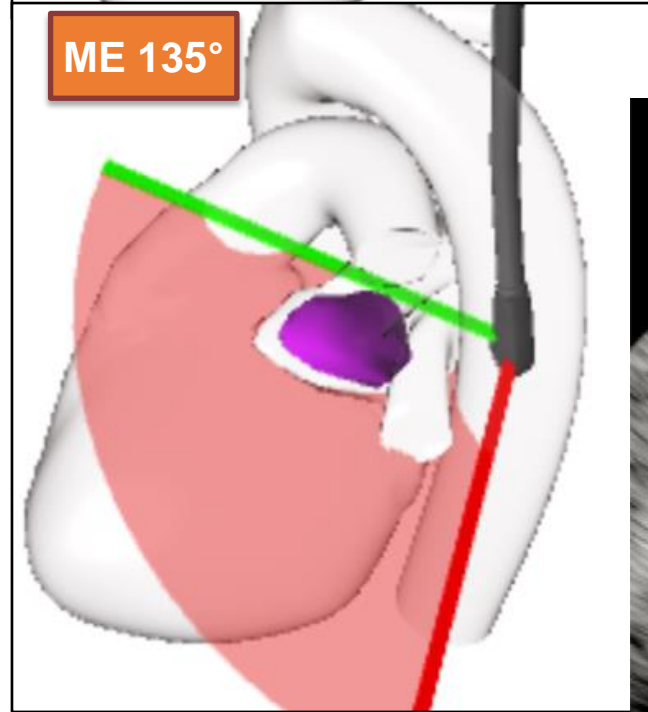
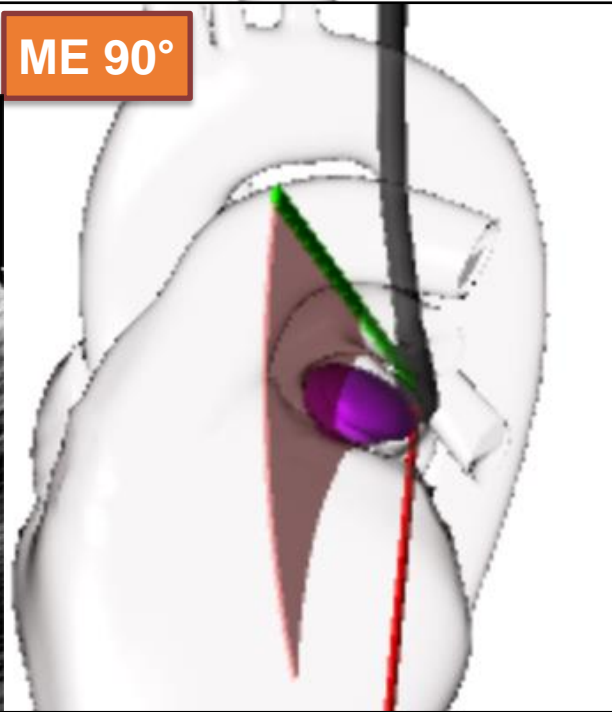
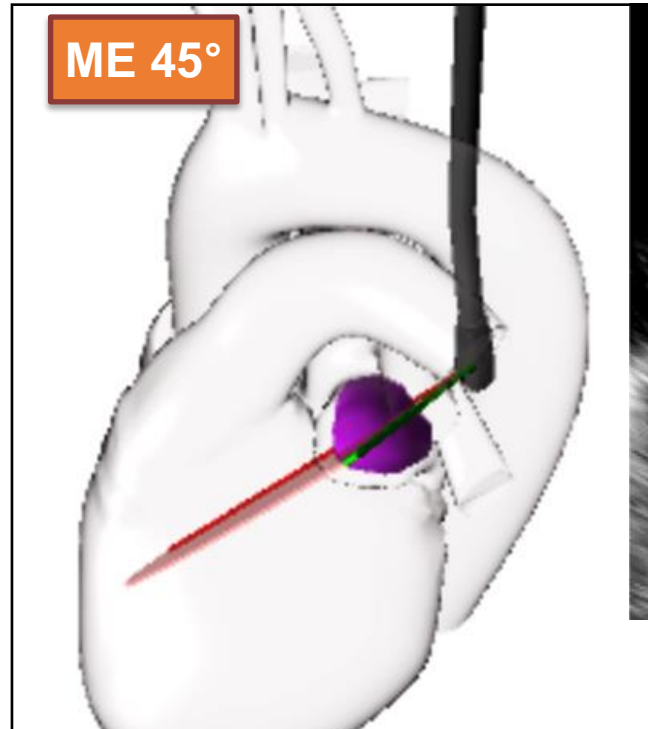
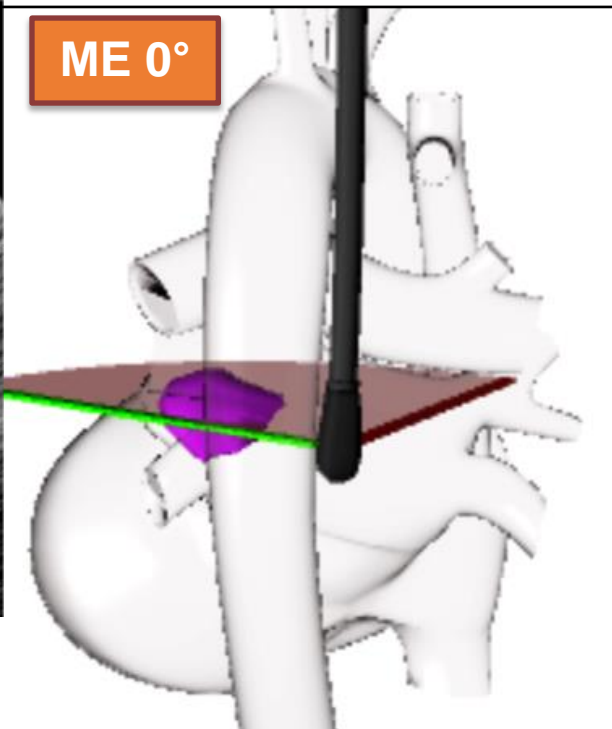
3D For The Sake of 3D

Be Realistic

Be Photo-realistic

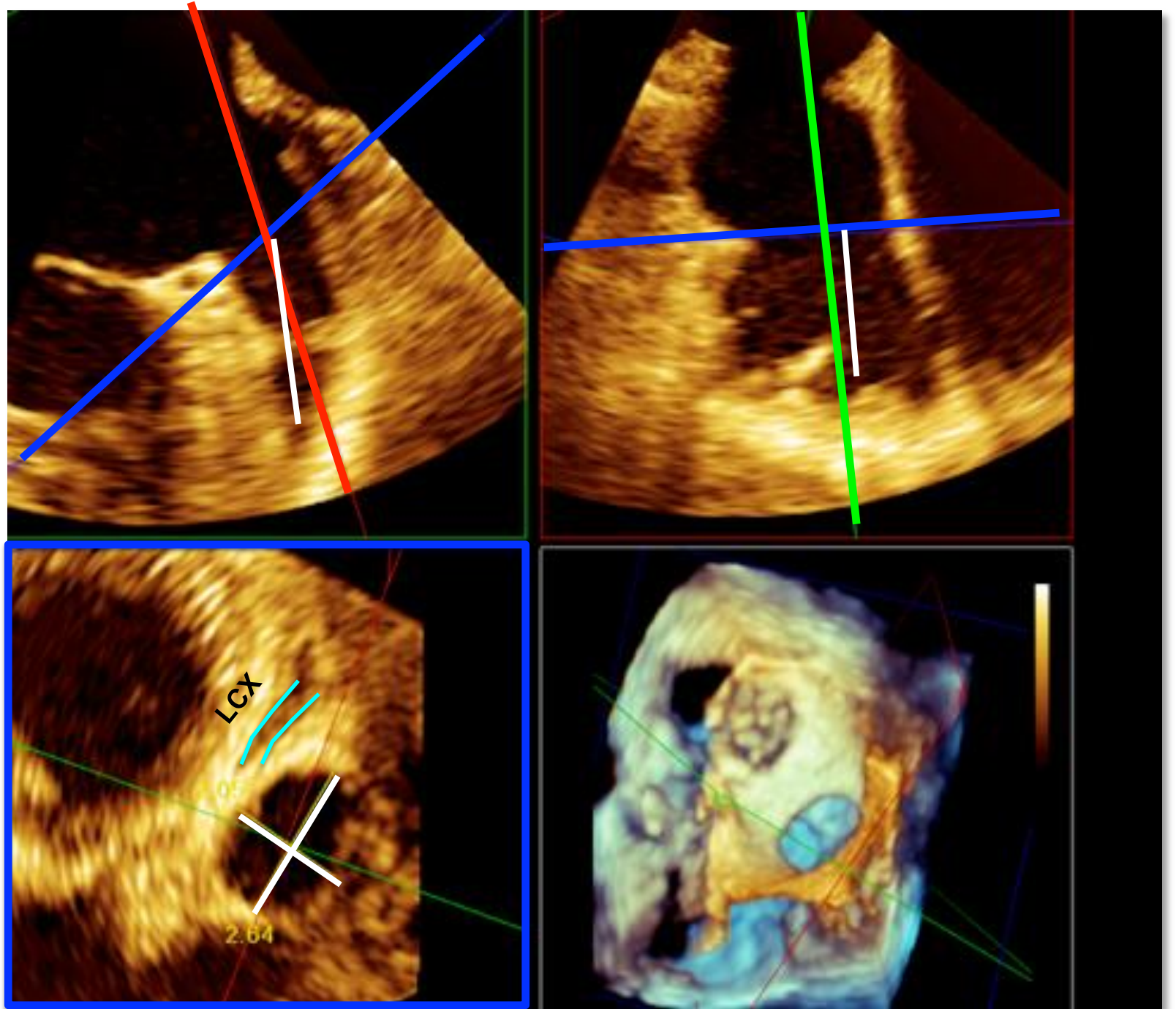
# 3D For The Sake Of 2D

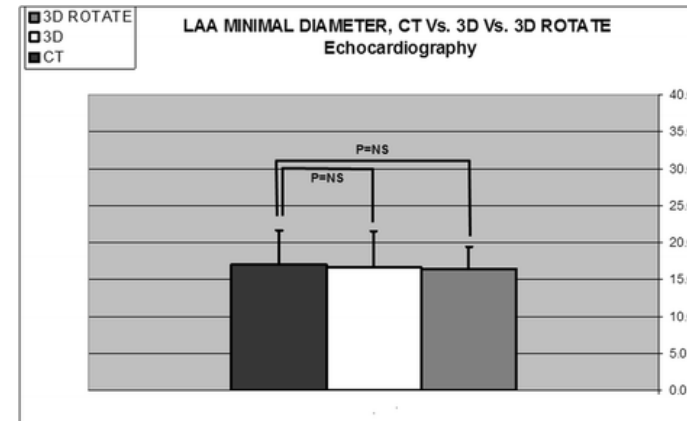
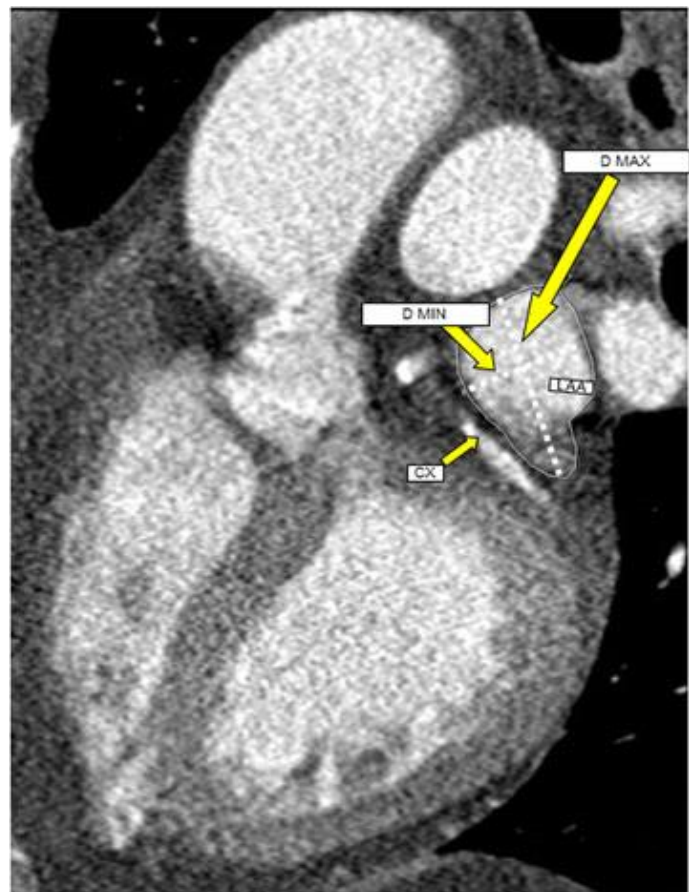
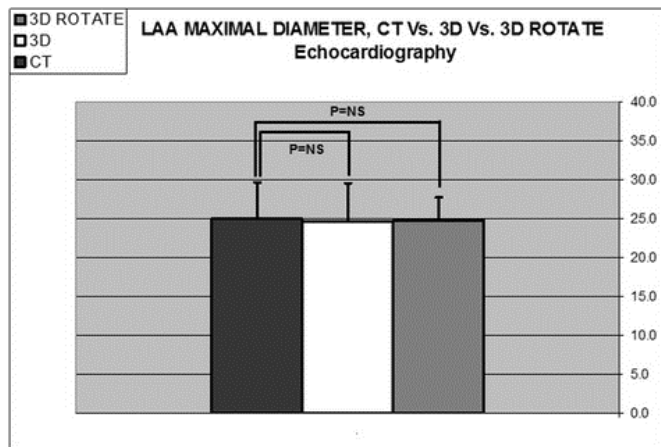
Multiplanar Reconstruction



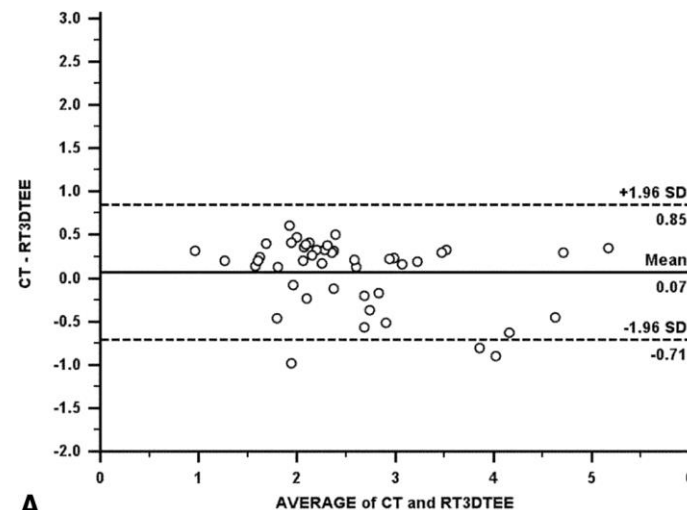
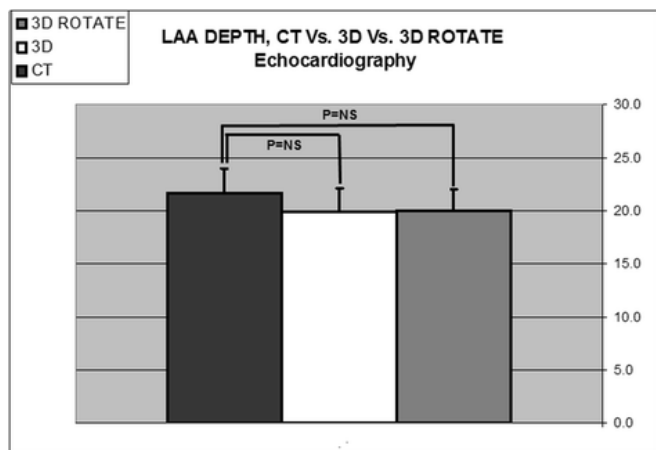


# MPR Multiplanar Reconstruction

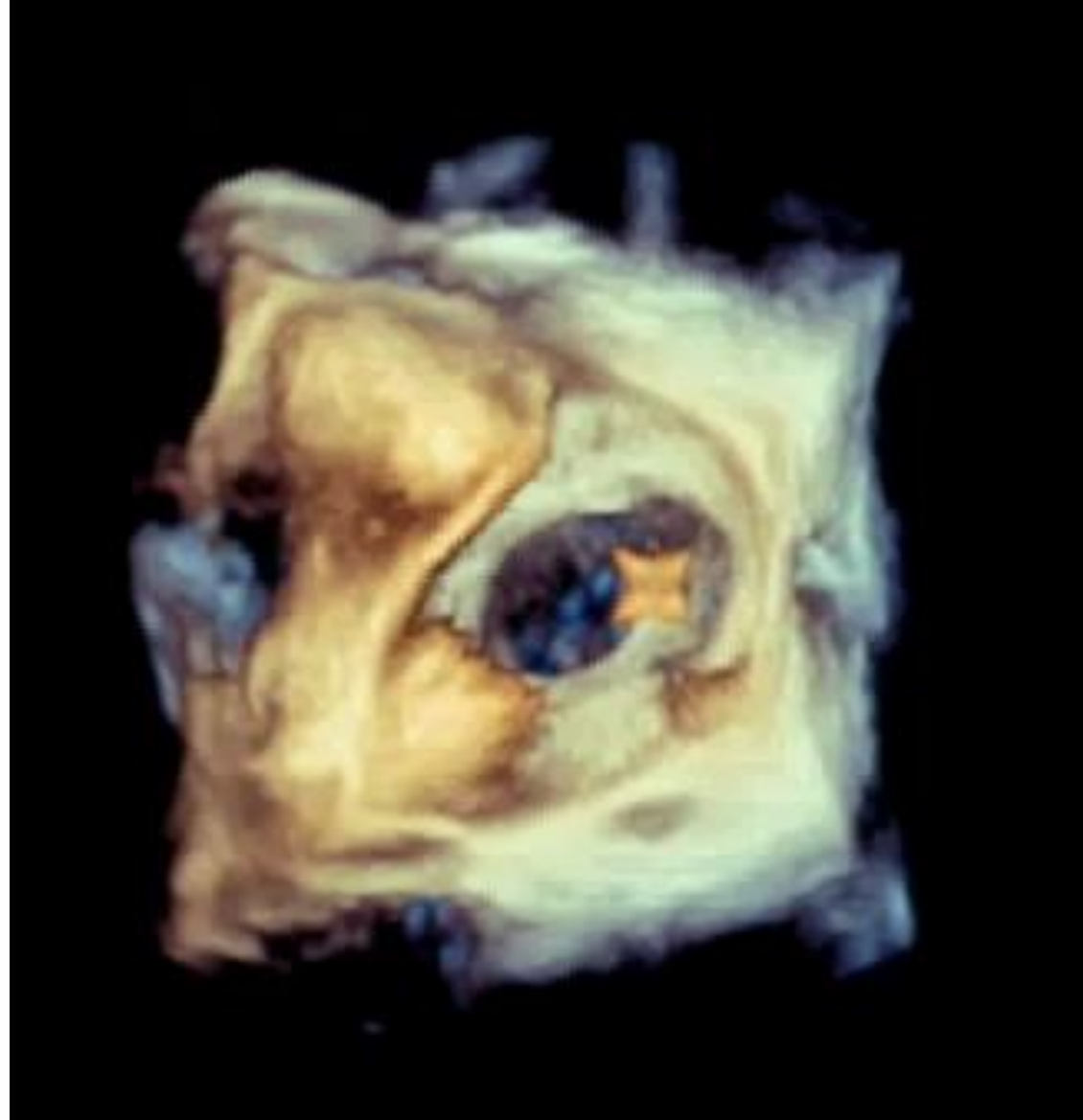




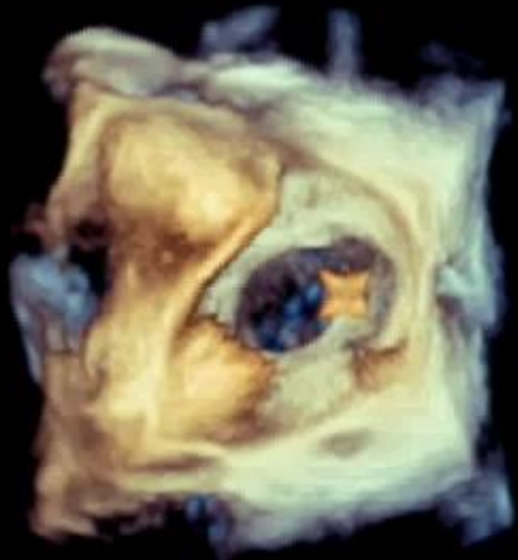
Yosefy et al. Cardiovasc Ultrasound. 2016 Aug 24;14(1):36



Nucifora et al. Circ Cardiovasc Imaging. 2011;4:514-523







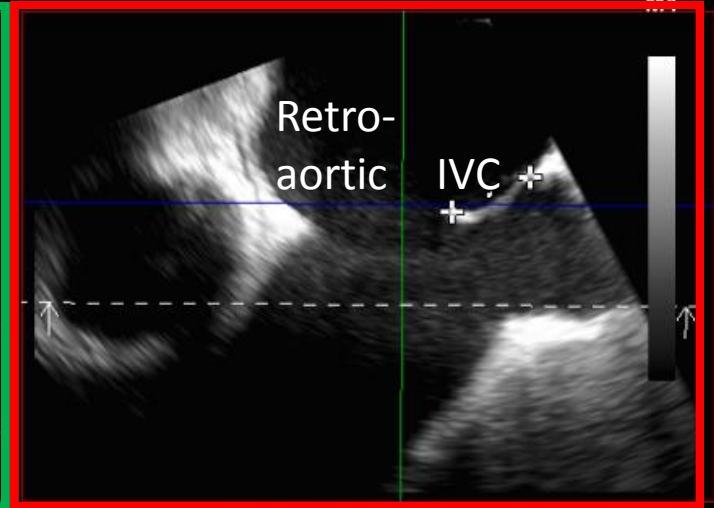
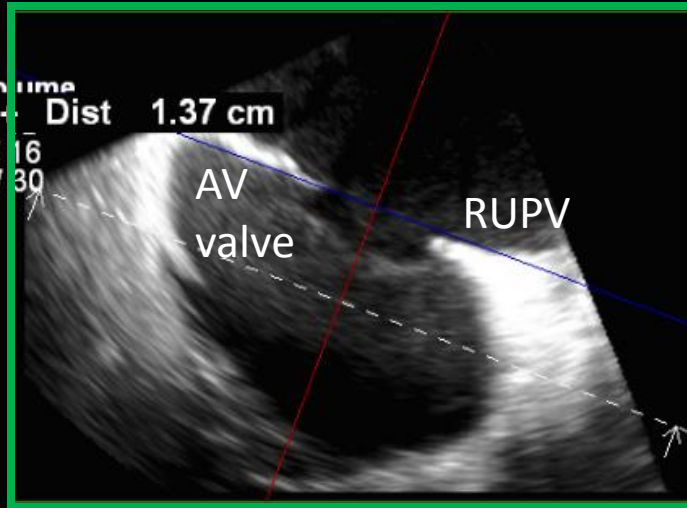
CUHK  
X8-2t  
50Hz  
9.1cm

30/06/2020 12:04:32

TISO.2 MI 0.2

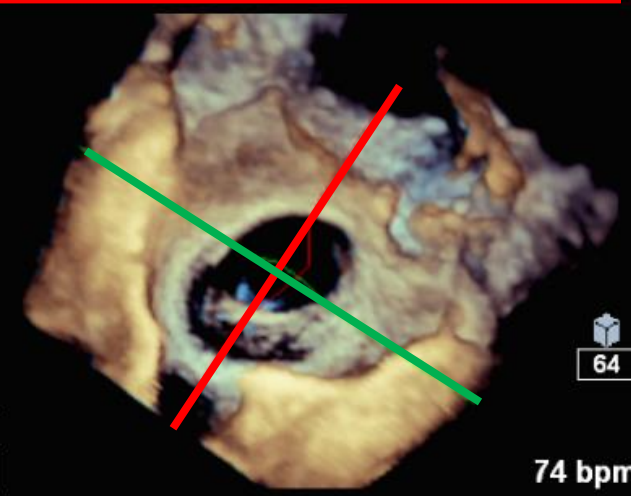
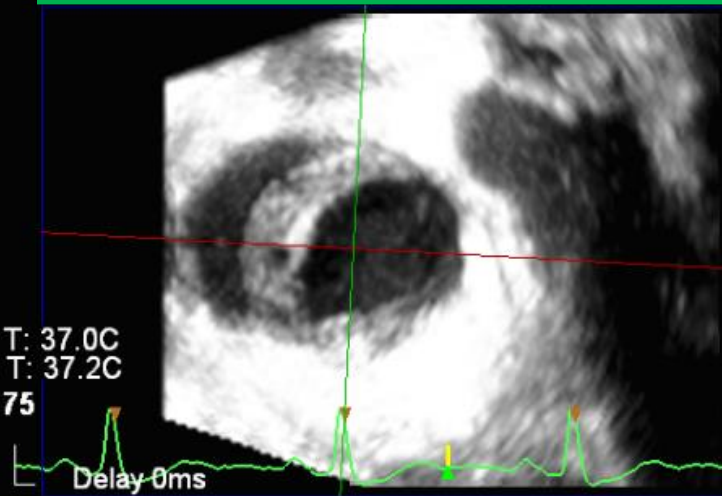
3D Beats 6Q

Full Volume  
2D / 3D  
% 56 / 16  
C 50 / 30  
Gen



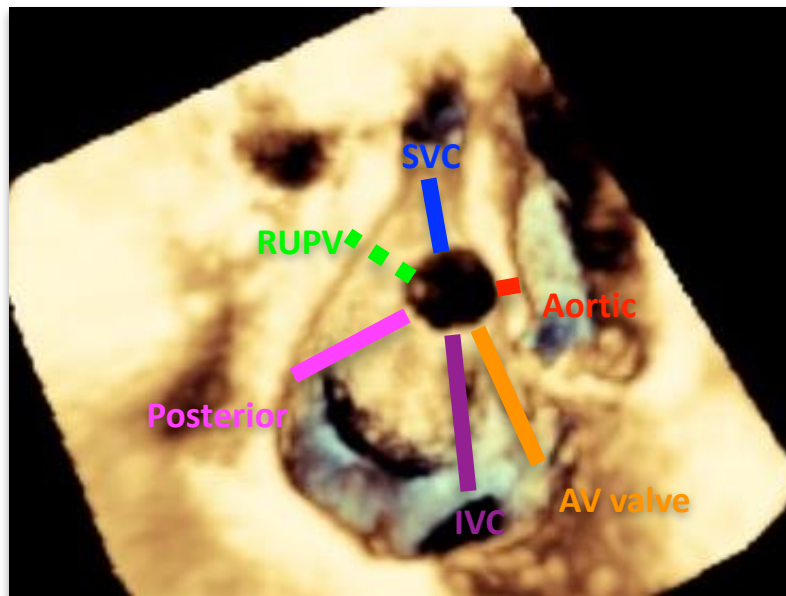
PAT T: 37.0C  
TEE T: 37.2C  
F# 75

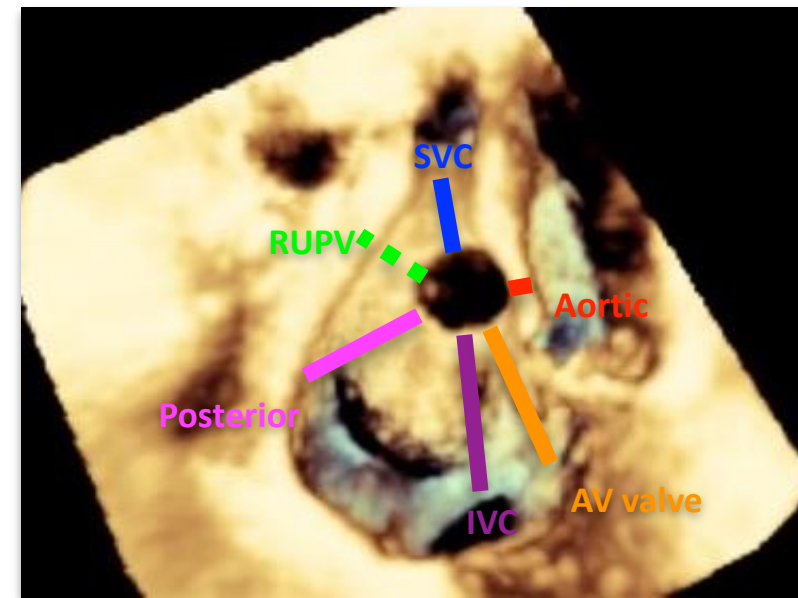
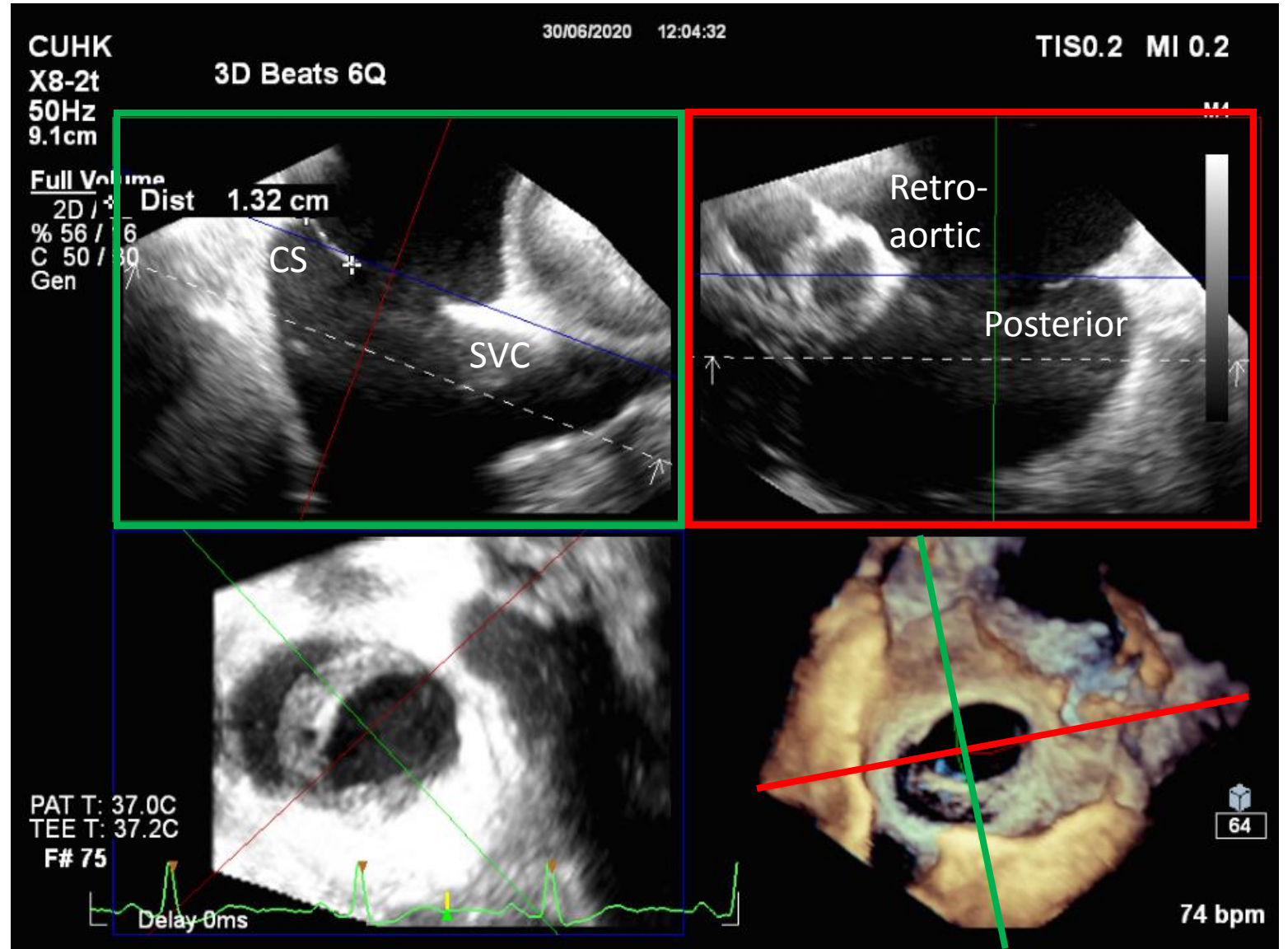
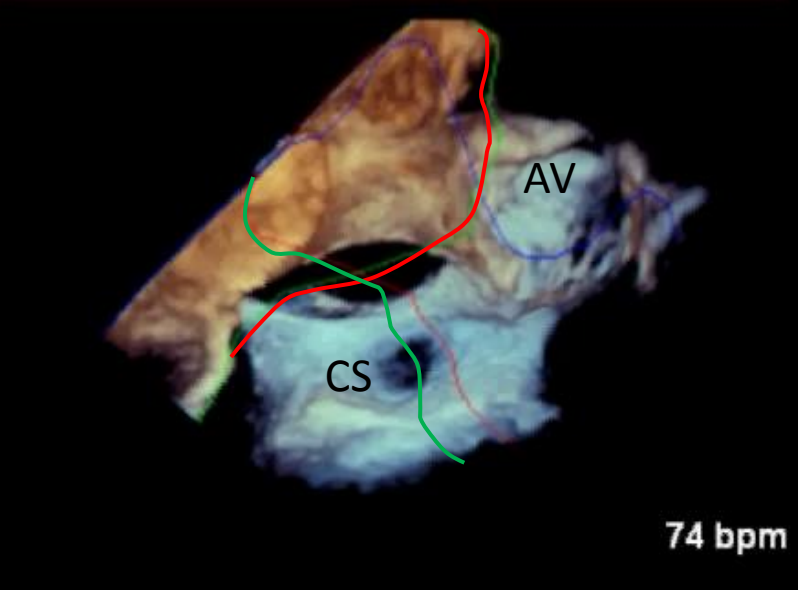
Delay 0ms

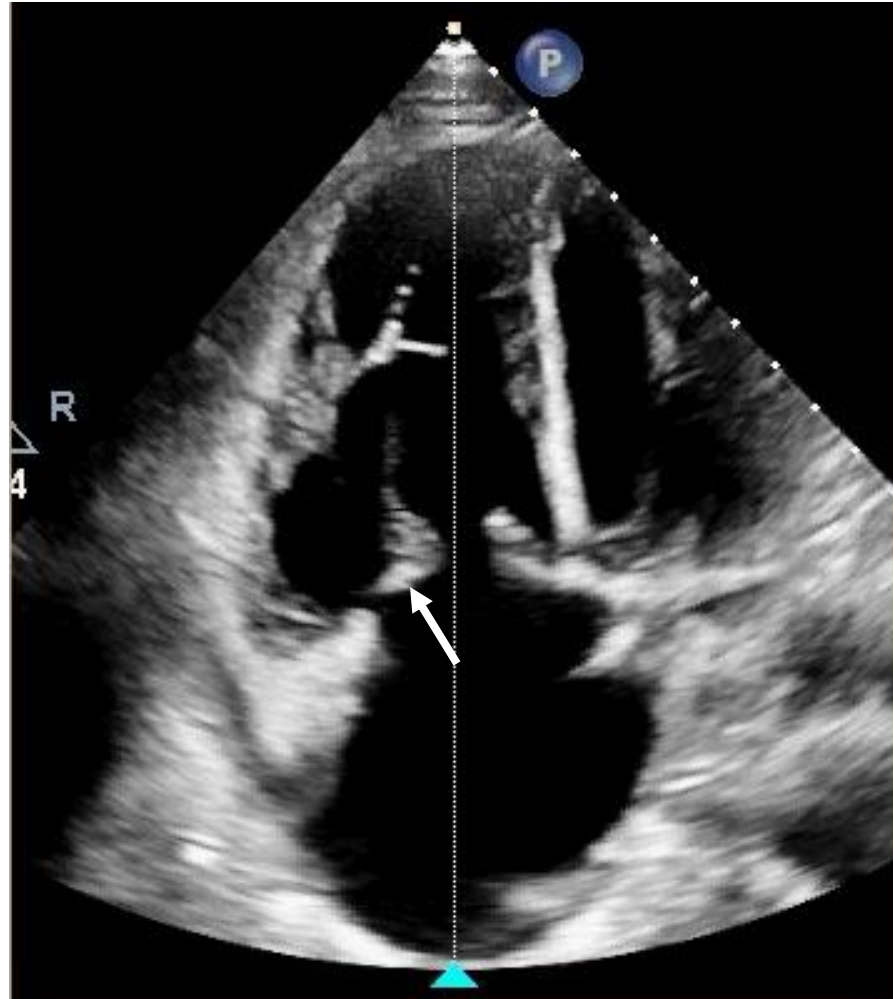


64

74 bpm







Which tricuspid leaflet is this?



PWHECHO

X5-1

40Hz

17cm

Live 3D

2D / 3D

% 83 / 52

C 49 / 41

HGen

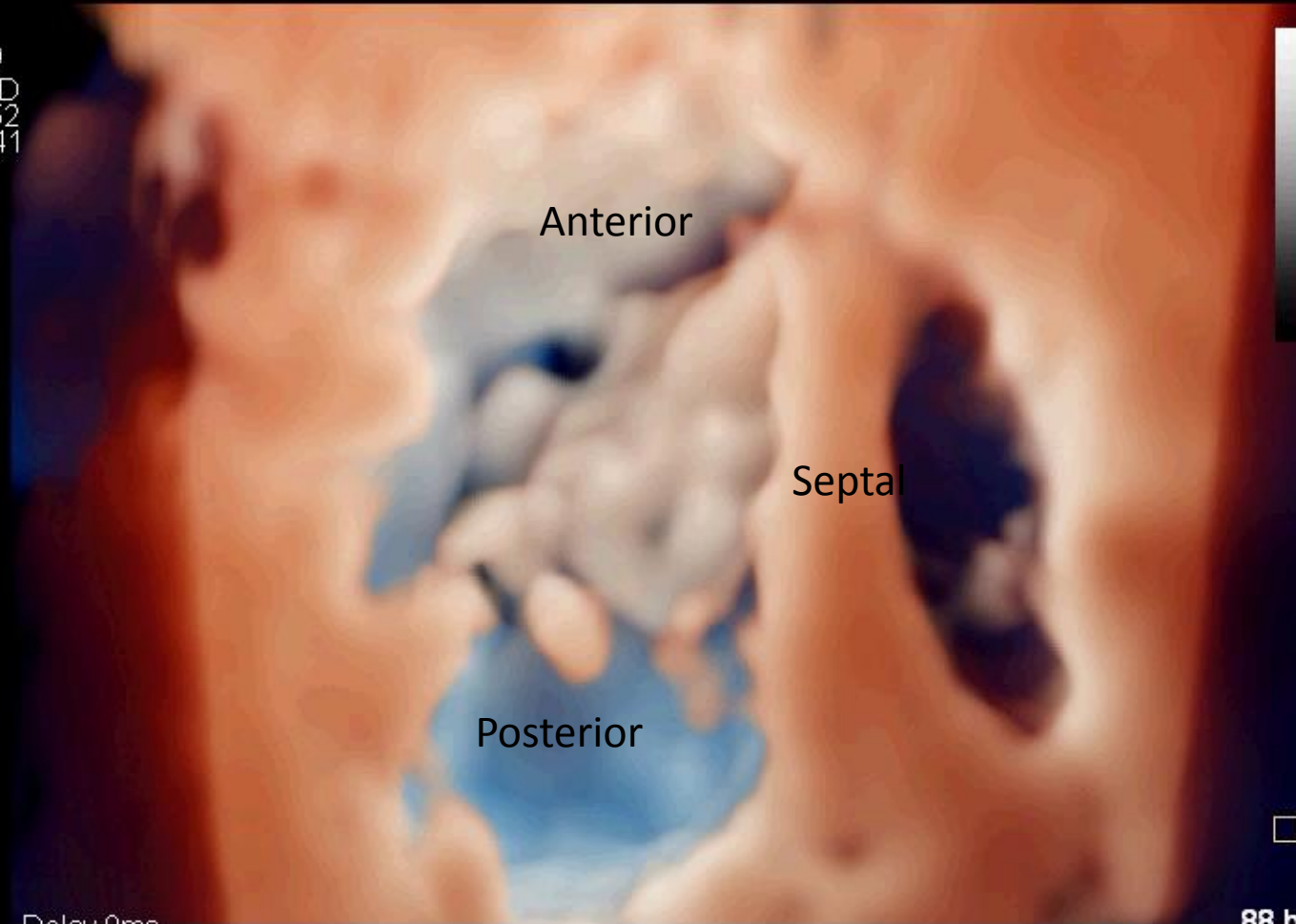
3D Beats 6

TIS0.4

MI 1.0

HR: 88

M1



JPEG

Delay 0ms

88 bpm

17-Feb-2020 4:10 PM



PWHECHO  
X5-1  
40Hz  
17cm

3D Beats 6

HR: 88  
TIS0.4 MI 1.0

Live 3D  
2D / 3D  
% 83 / 52  
C 49 / 41  
HGen

M1

A S

A P

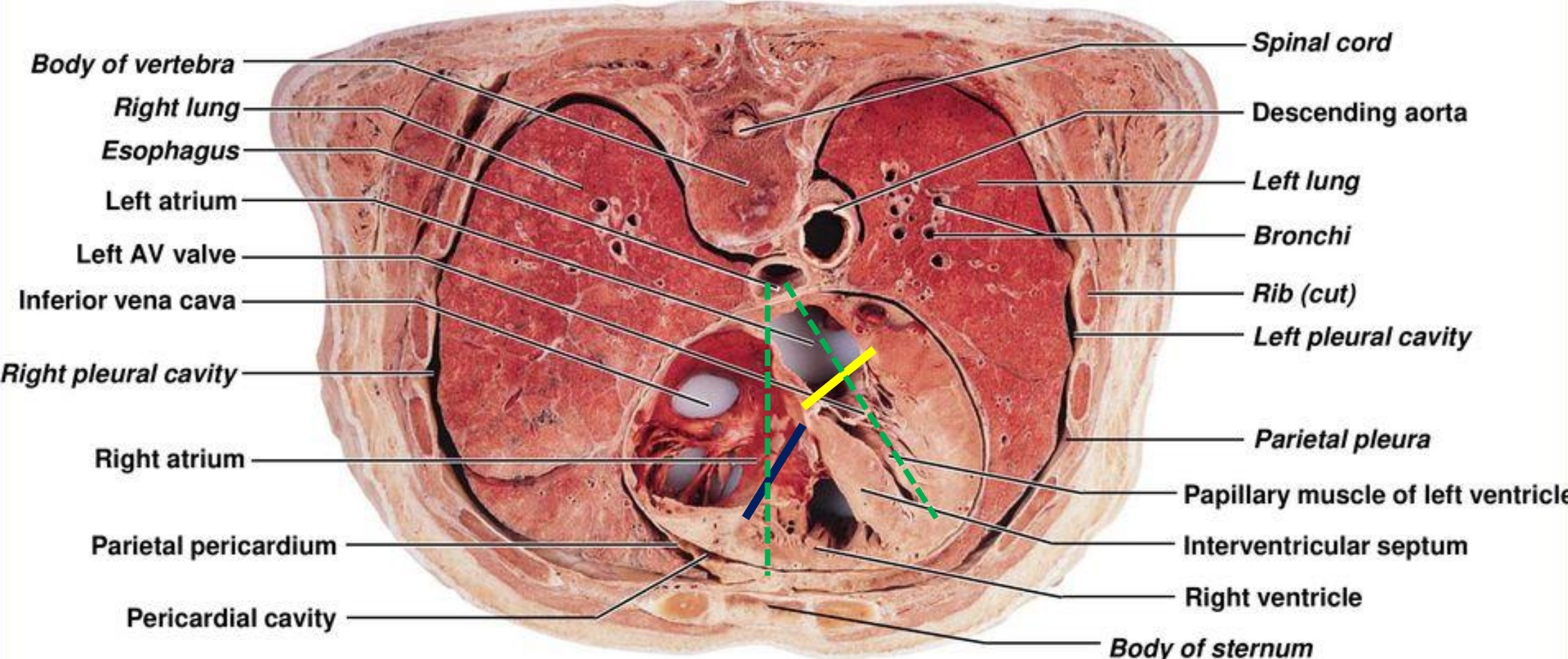
A S P

JPEG Delay 0ms

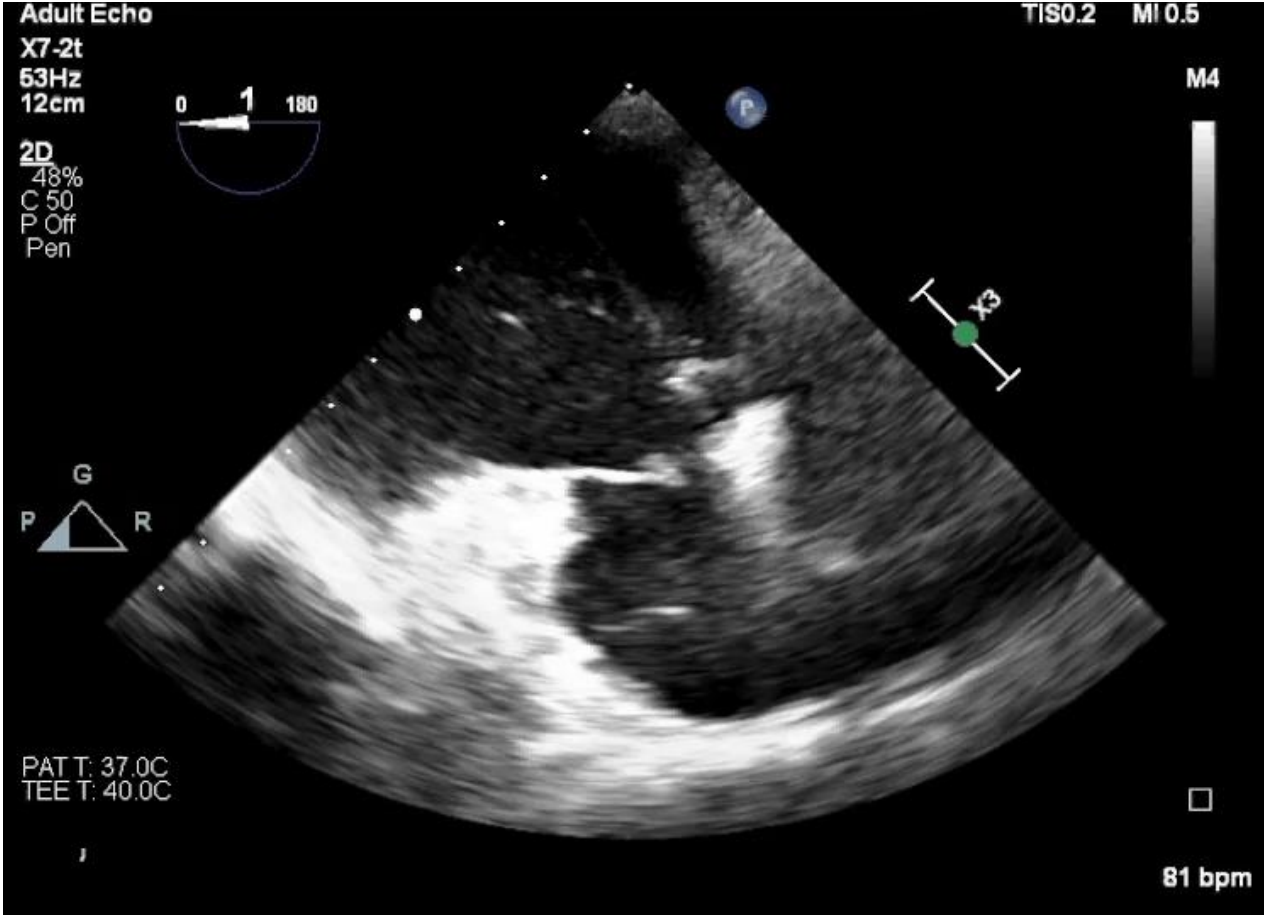
88 bpm  
17-Feb-2020 4:15 PM

# Orientation of the Heart in the Thorax

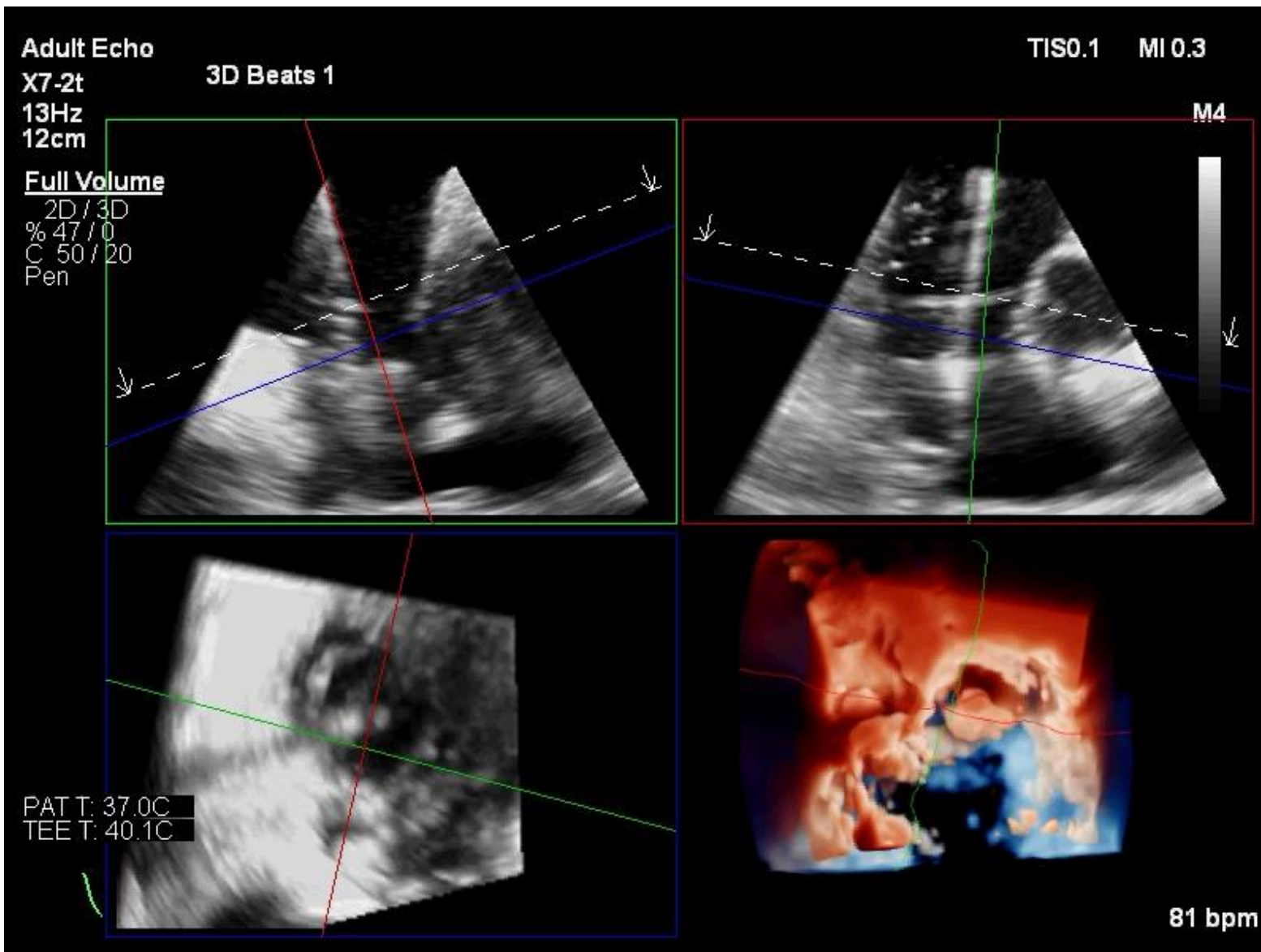
Why TV difficult to image on TEE?



# TriClip not in plane





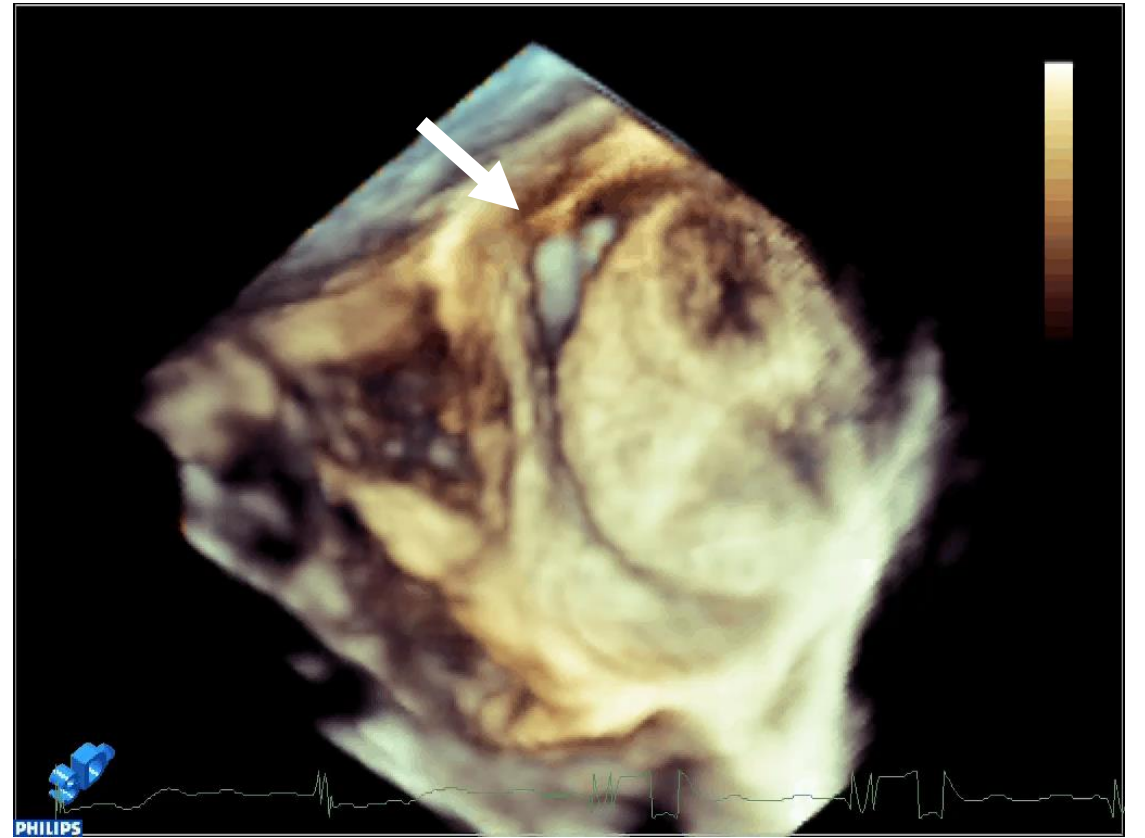


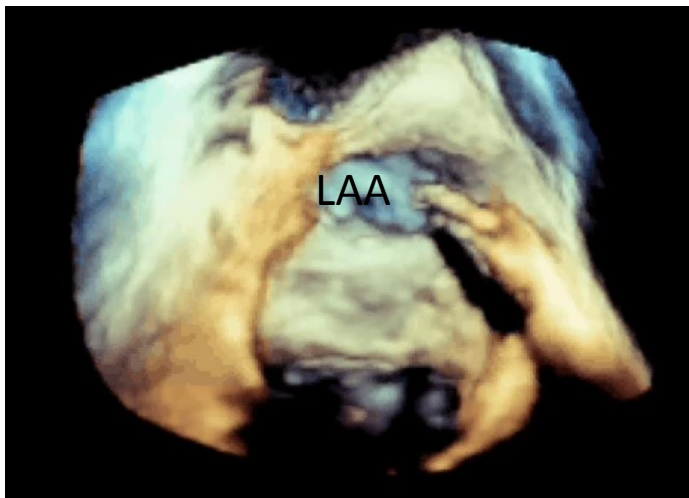
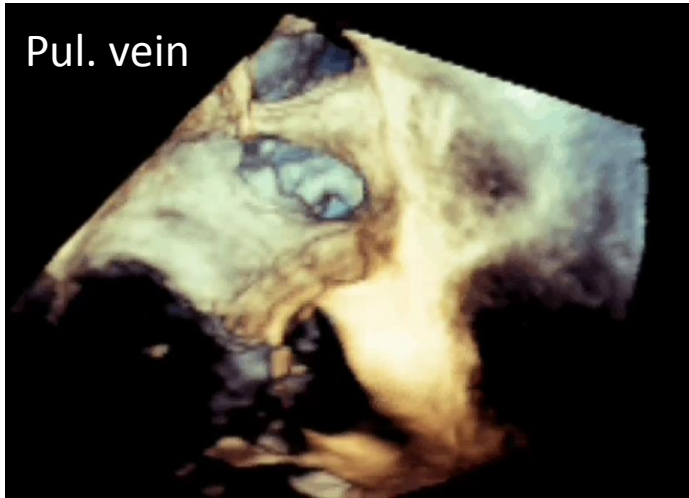
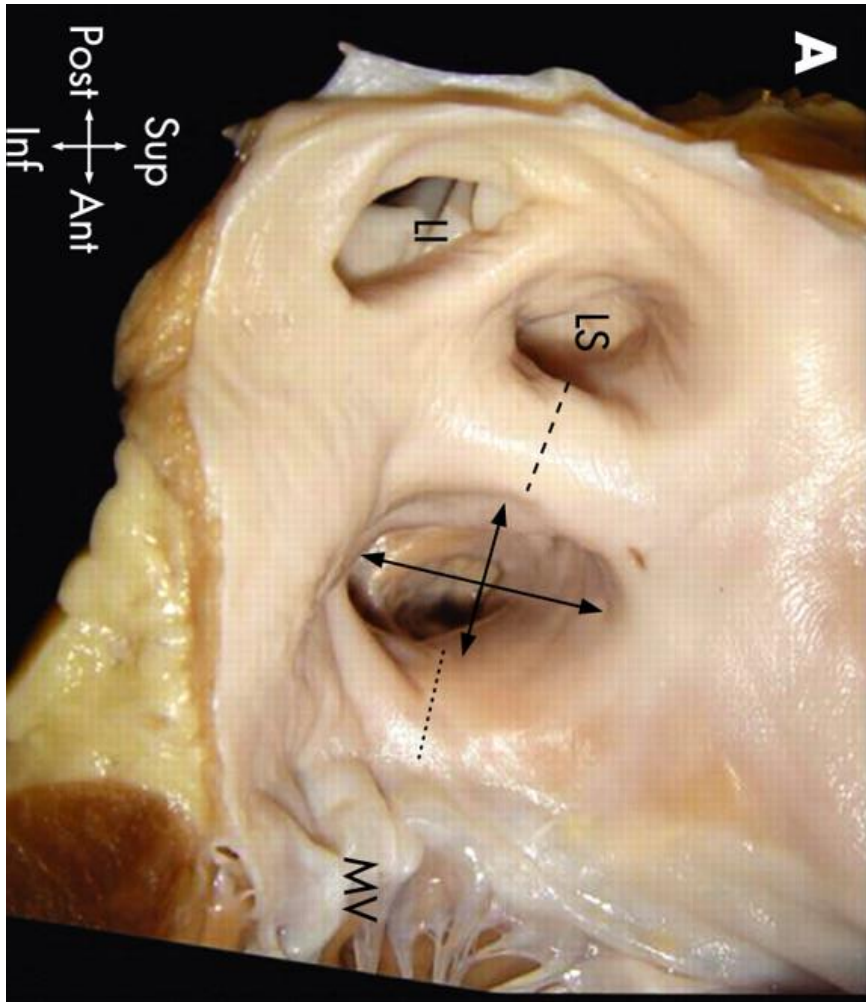
Multivue =  
Real-Time  
MPR



# 3D For The Sake of 3D

“En face” perspective

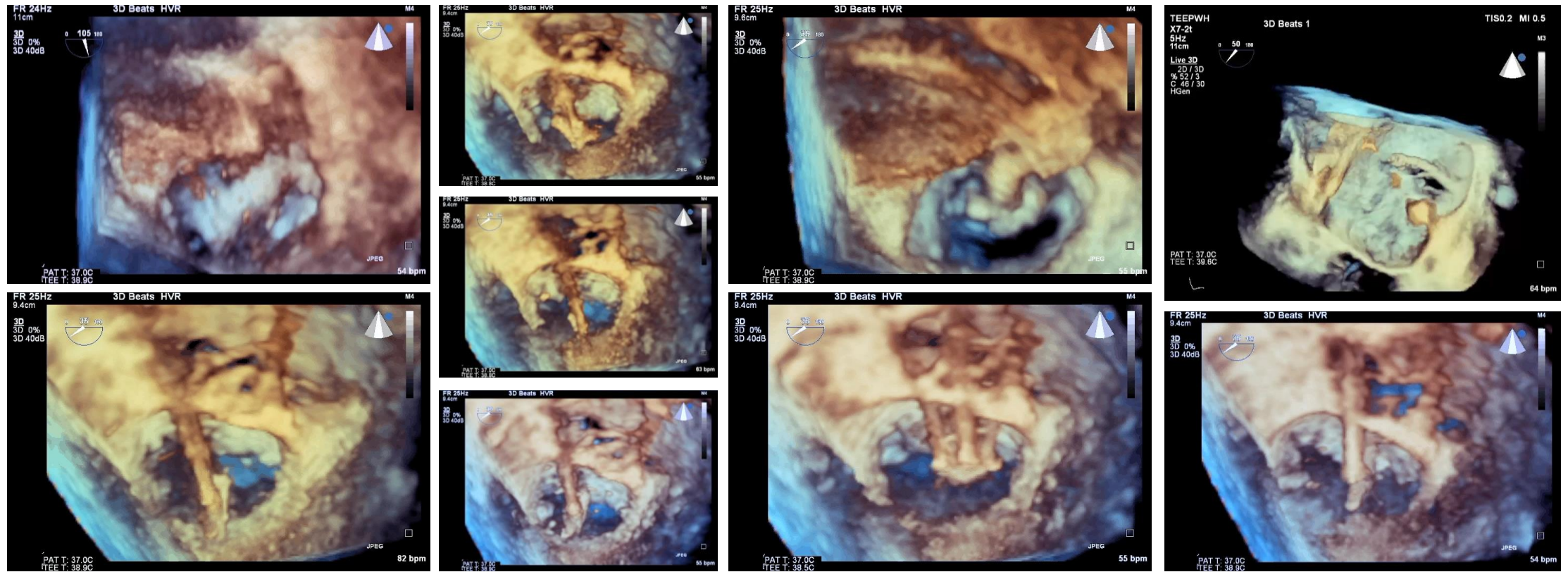




Catheter/wire  
position in  
pulmonary veins  
vs LAA

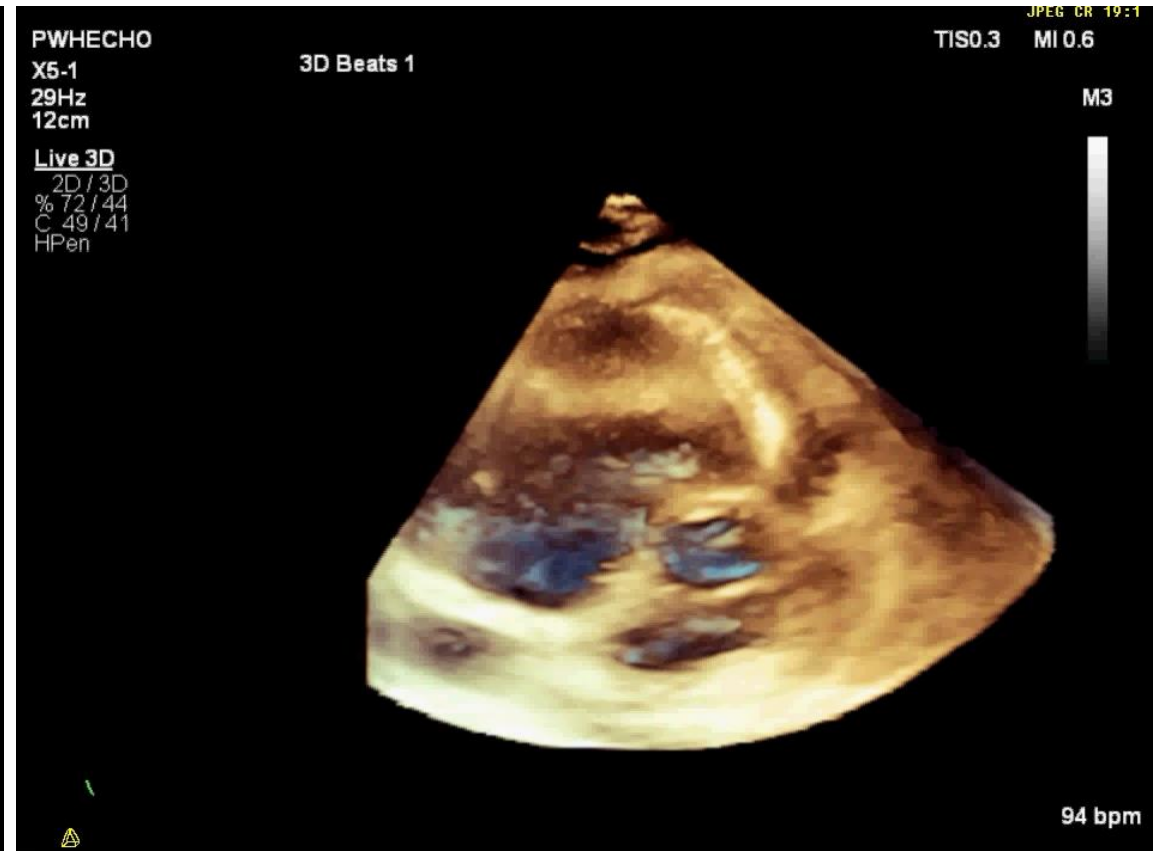
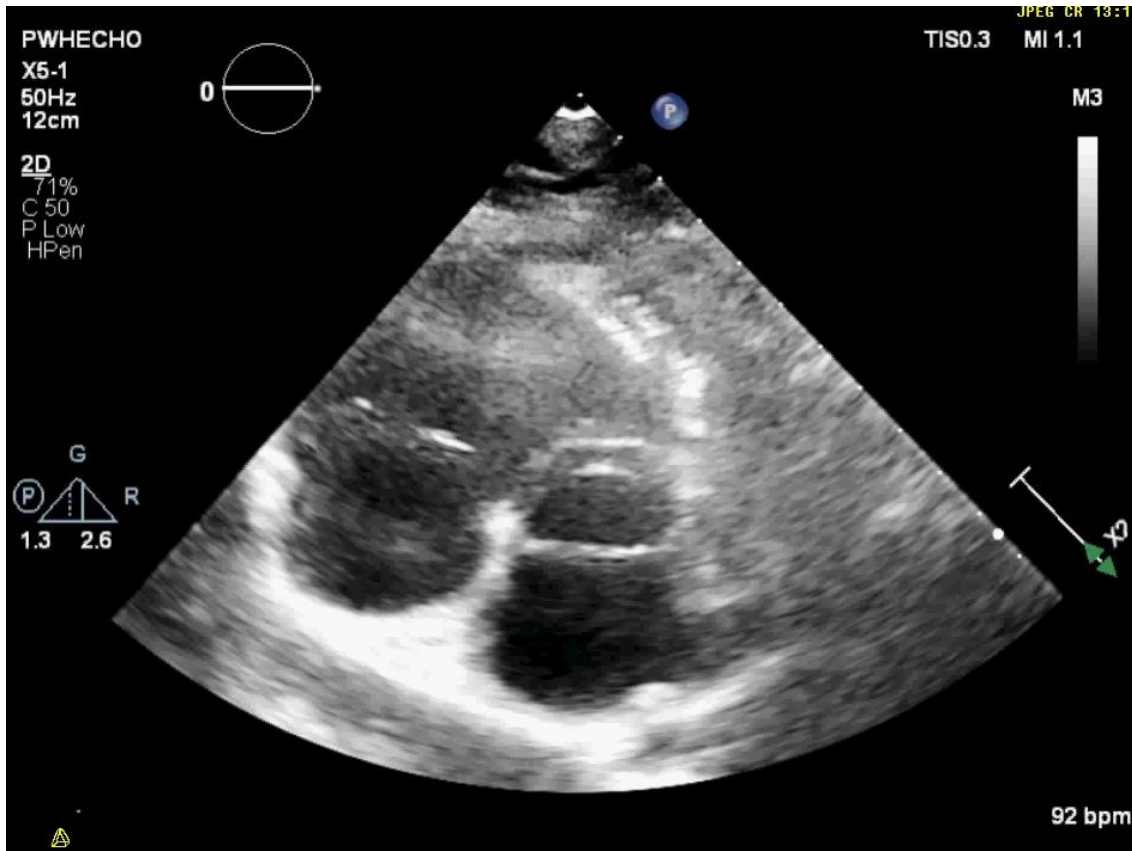


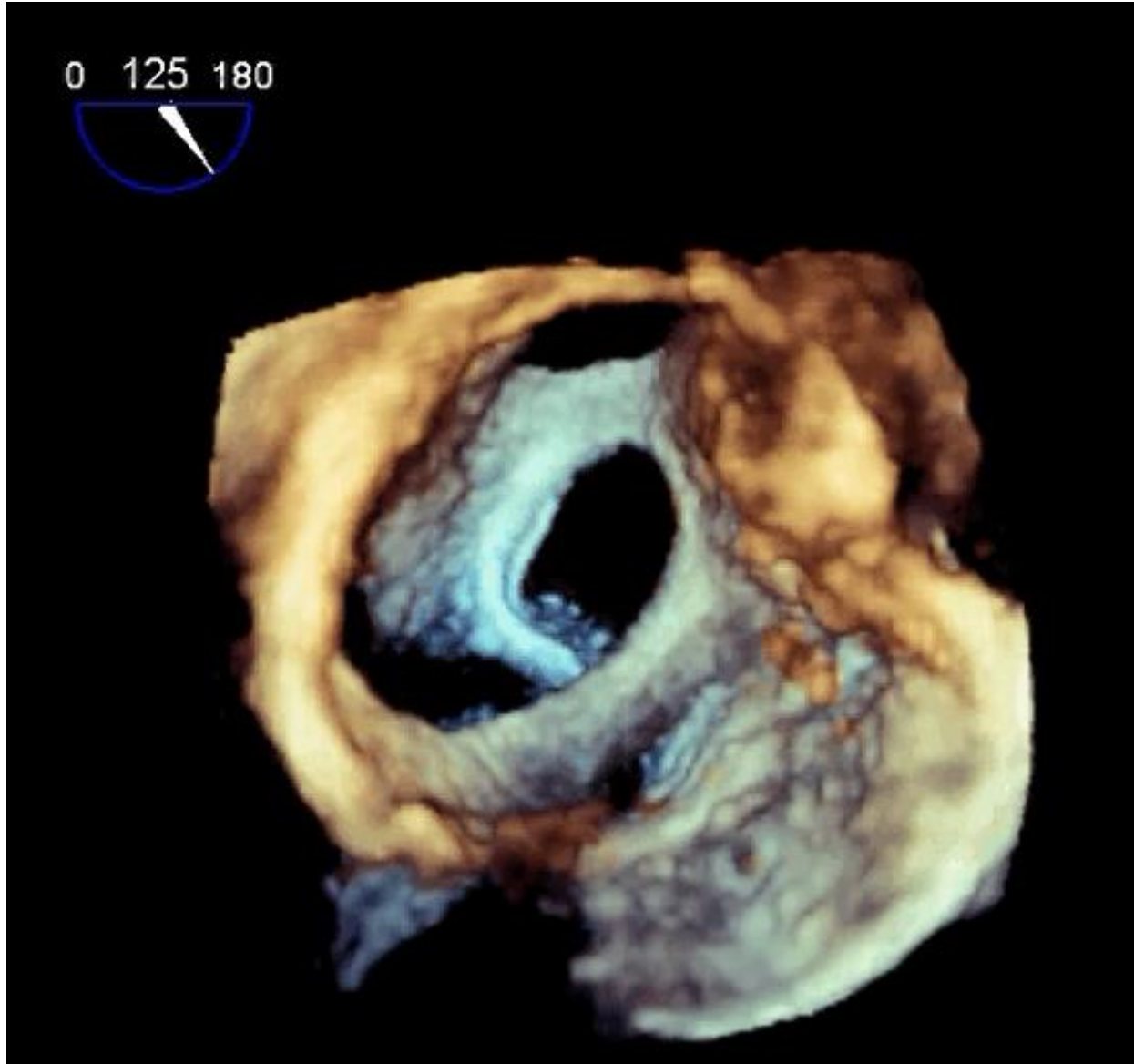
# MitraClip Steering and Perpendicularity in 3D





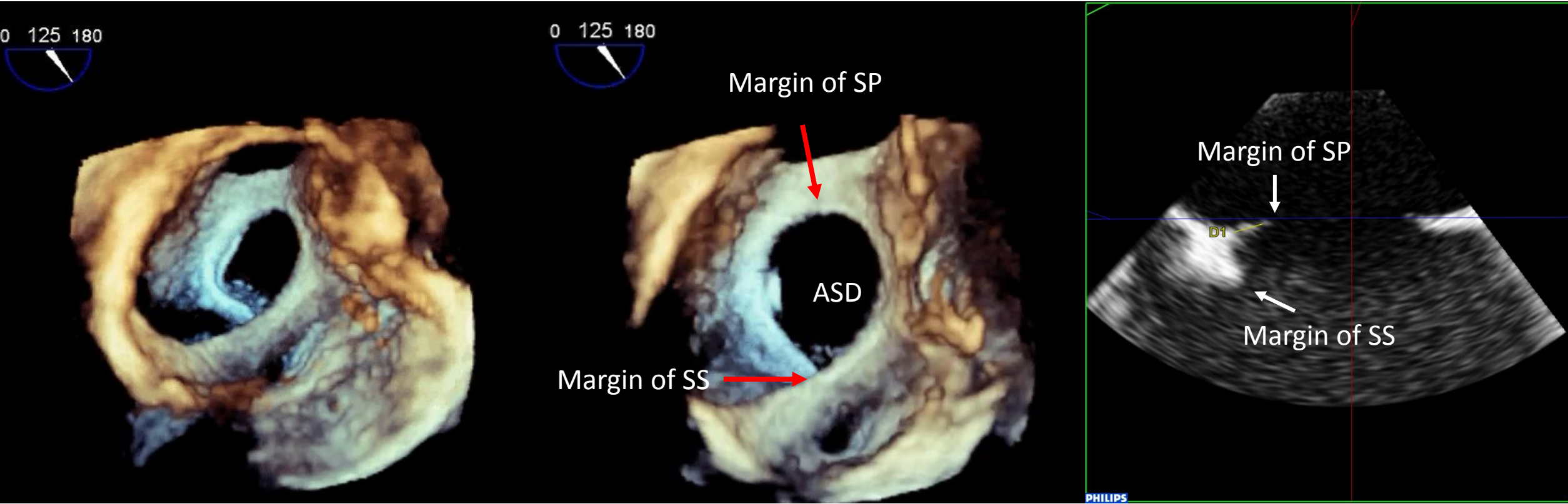
# Post-ASD closure D1 (done outside)

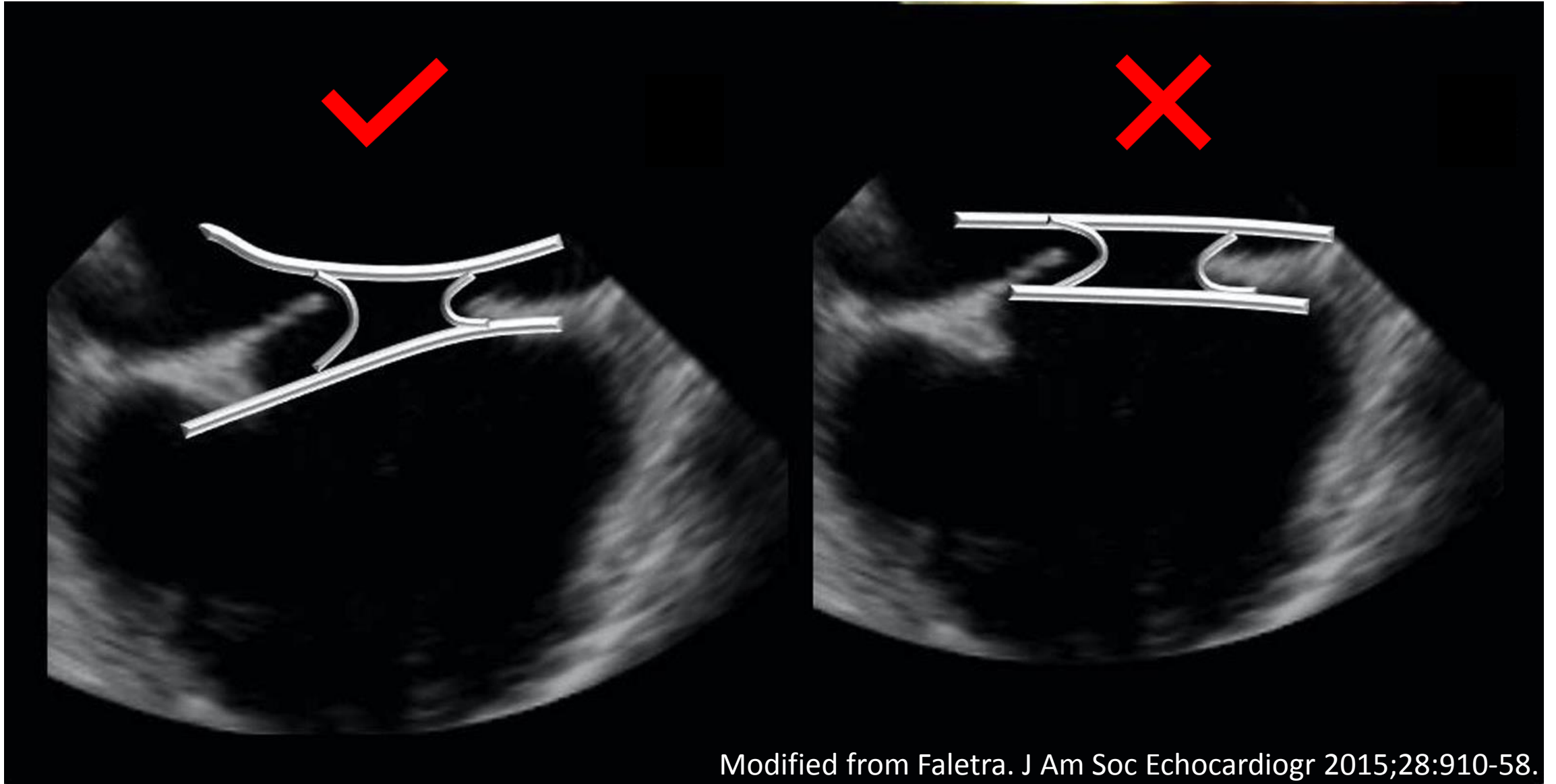




What additional information can 3D en face view tell us before ASD closure?

# Septal malalignment of ASD



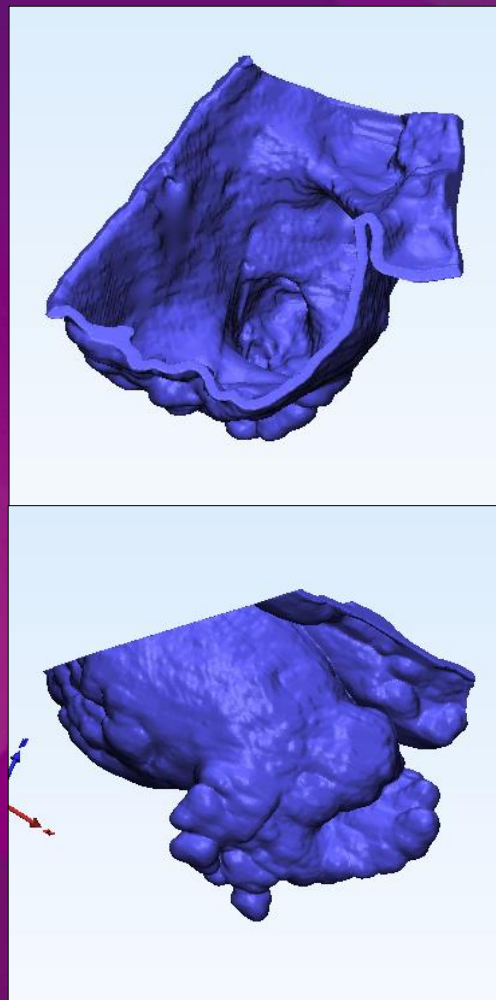


Modified from Faletra. J Am Soc Echocardiogr 2015;28:910-58.



# Be Realistic

3D Printing



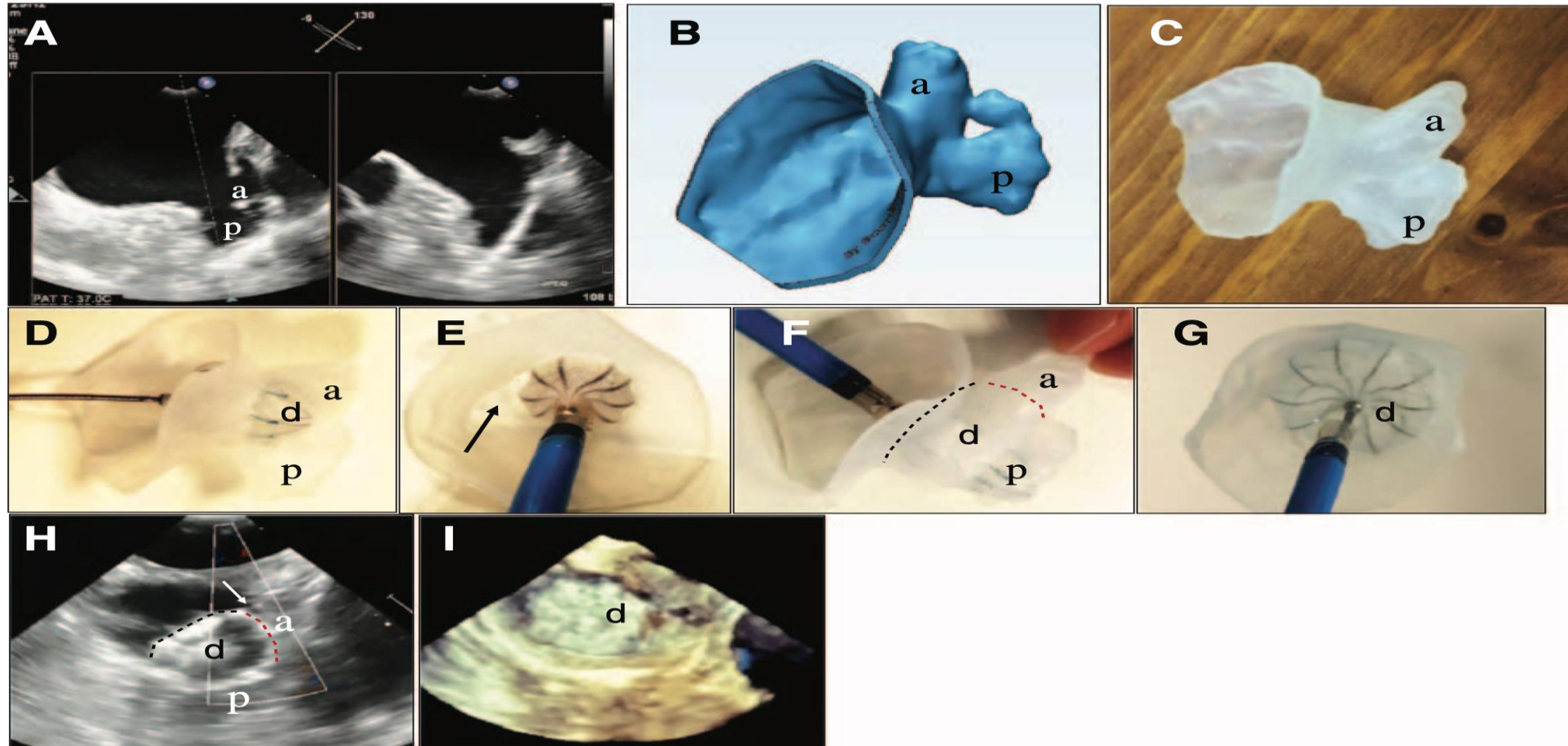
LAA Imaging  
3DTEE

Image Post-  
processing

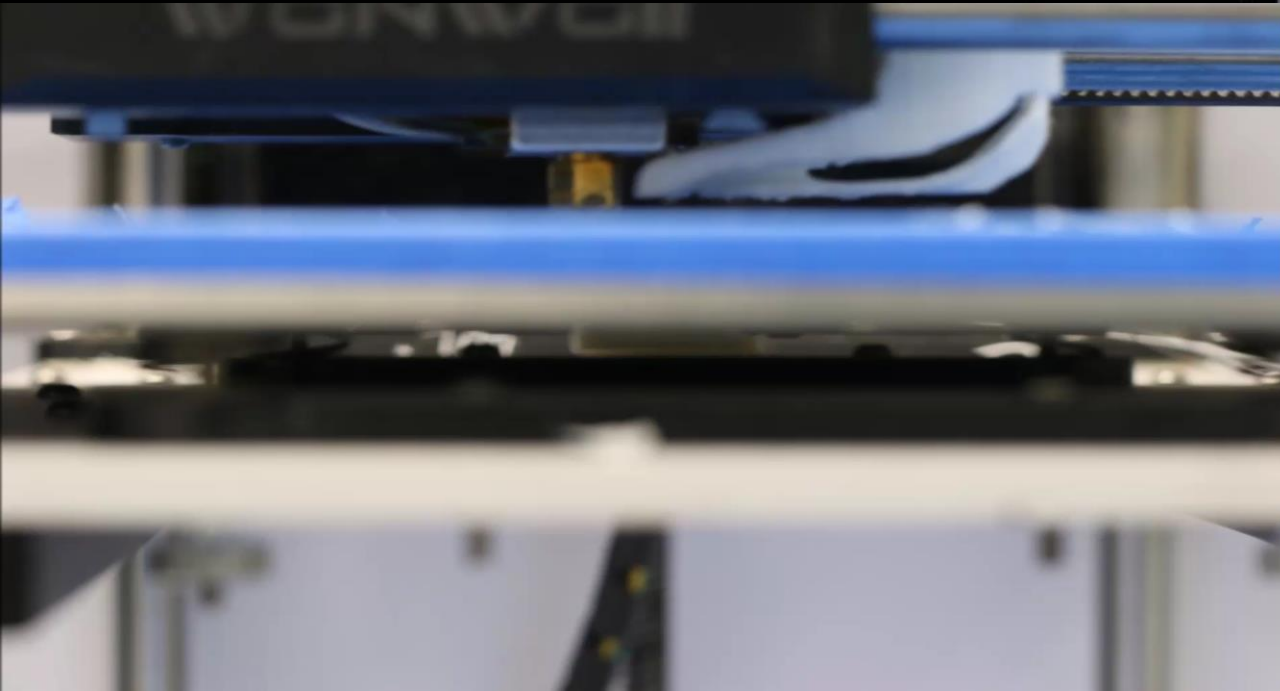
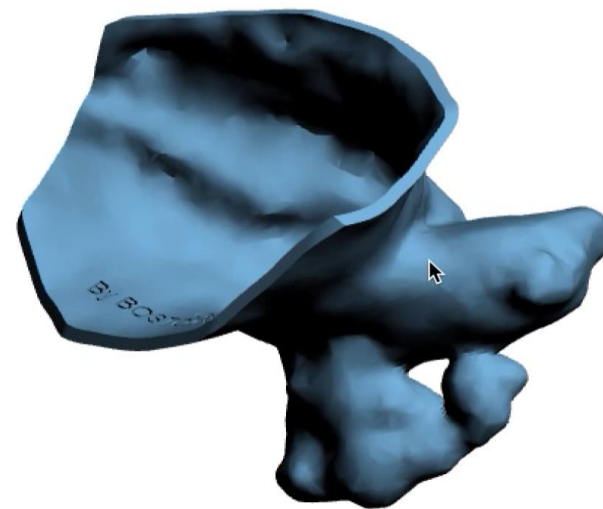
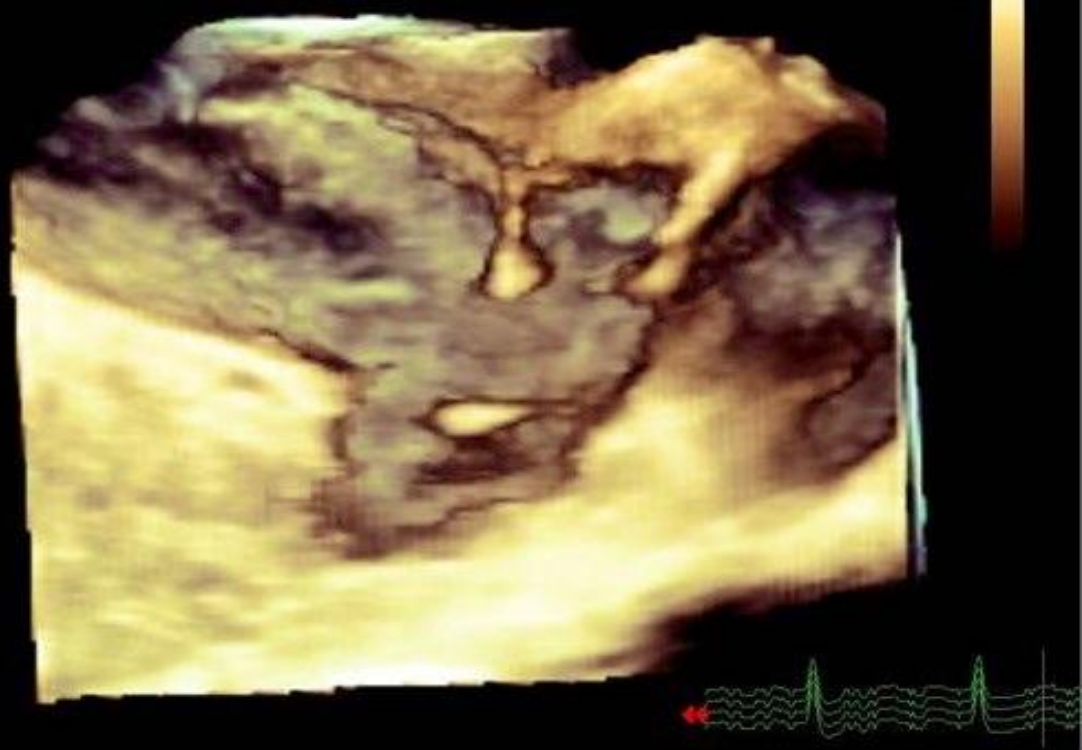
3D Printed  
Model

## Three-Dimensional Printing for Planning Occlusion Procedure for a Double-Lobed Left Atrial Appendage

Yiting Fan, Ka-Wai Kwok, Yiqun Zhang, Gary Shing-Him Cheung, Anna Kin-Yin Chan and Alex Pui-Wai Lee





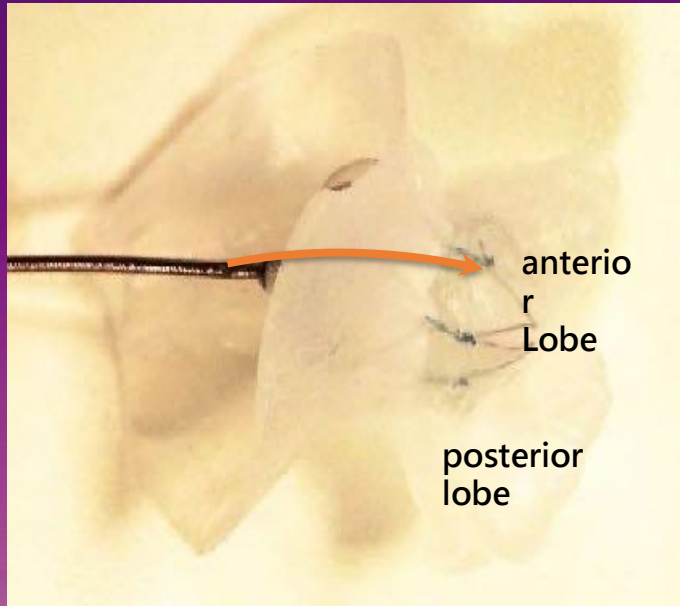




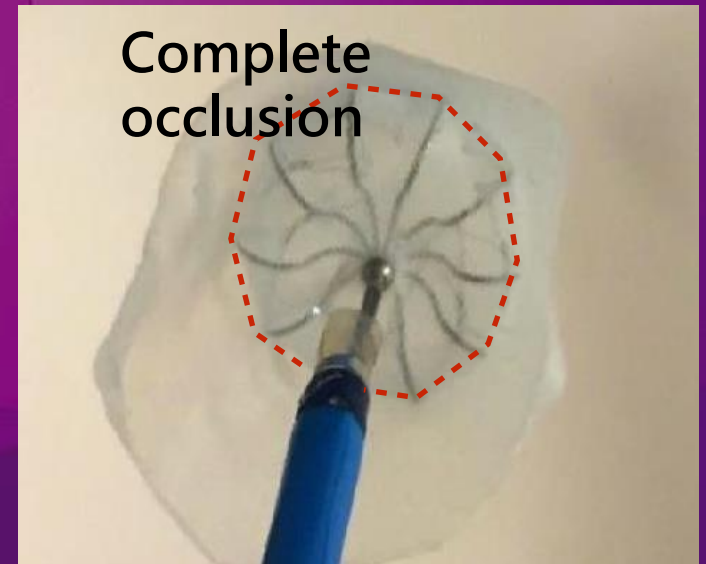
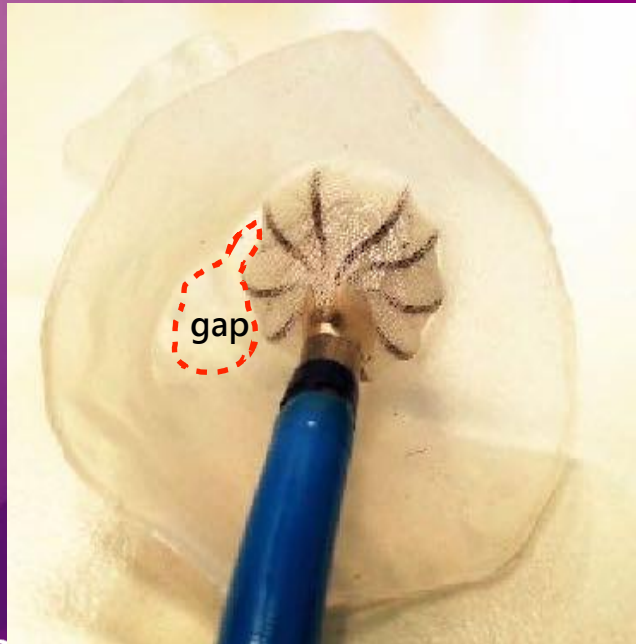
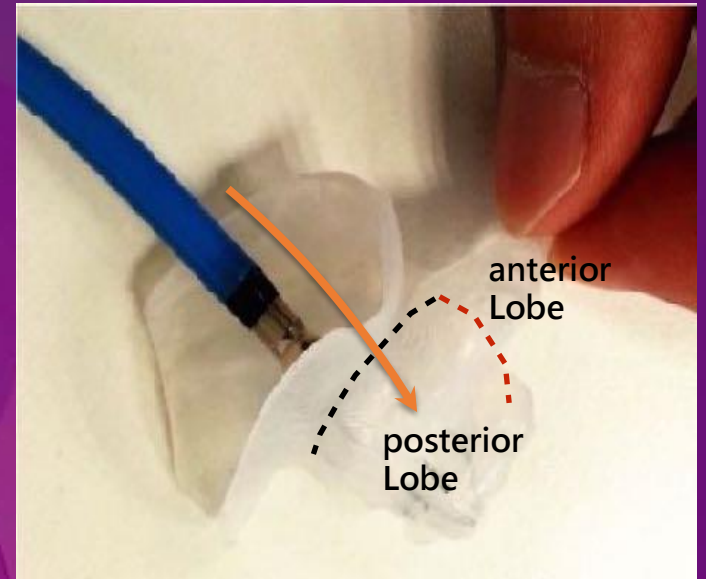
# Personalised procedural planning on 3D-printed LAA model



24mm  
WATCHMAN®  
device  
positioned in  
the **anterior**  
lobe



24mm  
WATCHMAN®  
device  
positioned in  
the **posterior**  
lobe



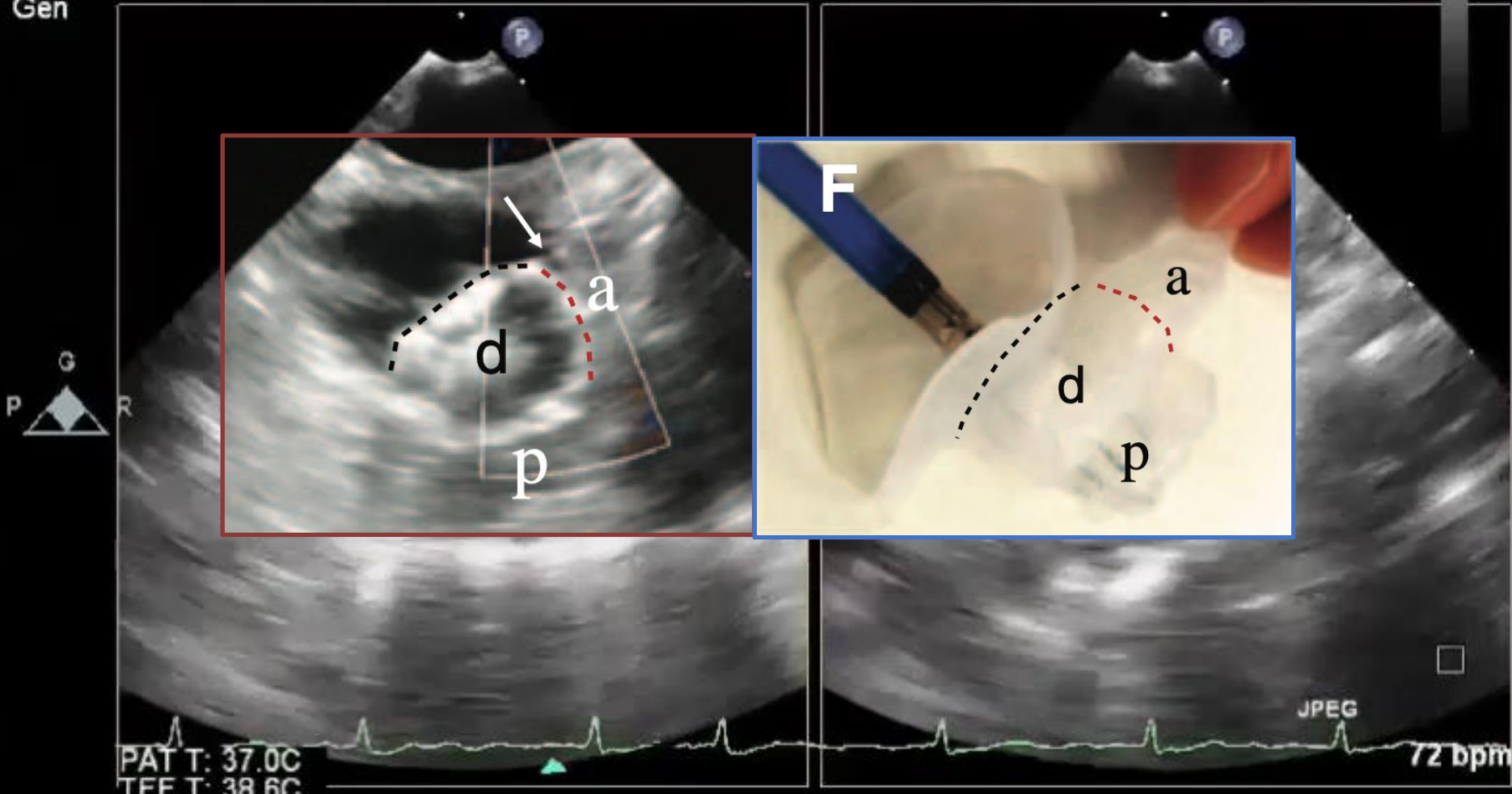
FR 29Hz  
8.1cm

xPlane  
67%  
67%  
50dB  
P Off  
Gen



M4

# Intra-procedural TEE





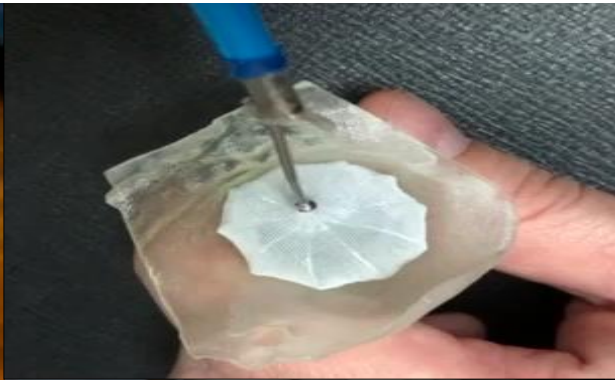
# CLINICAL INVESTIGATIONS

## ECHOCARDIOGRAPHY-BASED THREE-DIMENSIONAL PRINTING

### Device Sizing Guided by Echocardiography- Based Three-Dimensional Printing Is Associated with Superior Outcome after Percutaneous Left Atrial Appendage Occlusion



Yiting Fan, MD, Fan Yang, MD, Gary Shing-Him Cheung, MBBS, Anna Kin-Yin Chan, MBChB, Dee Dee Wang, MD, Yat-Yin Lam, MD, Marco Chun-Kit Chow, MPhil, Martin Chun-Wing Leong, MPhil, Kevin Ka-Ho Kam, MBChB, Kent Chak-Yu So, MBChB, Gary Tse, MD, Zhiqing Qiao, MD, Ben He, MD, FACC, Ka-Wai Kwok, PhD, and Alex Pui-Wai Lee, MD, FACC, *Hong Kong SAR and Shanghai, China; and Detroit, Michigan*



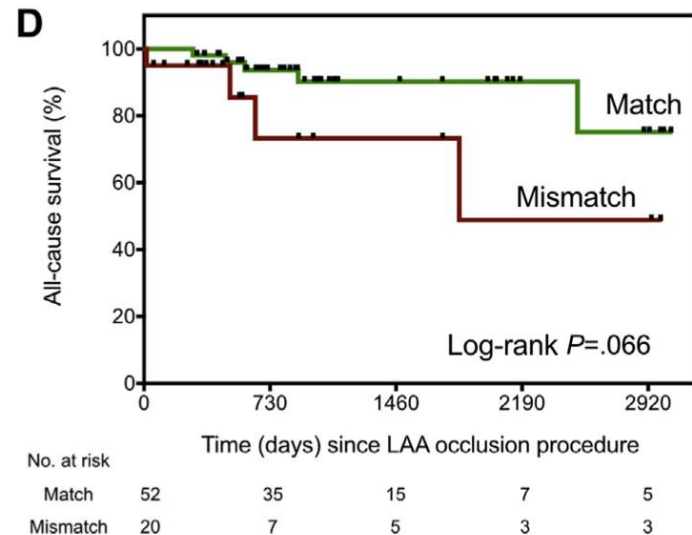
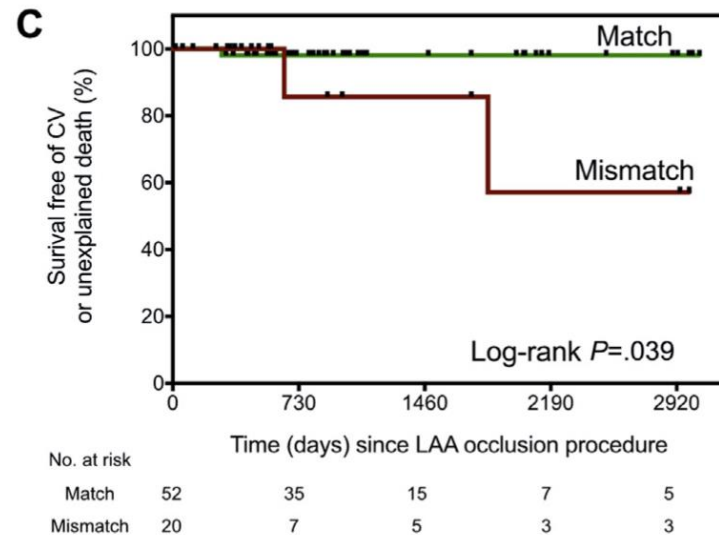
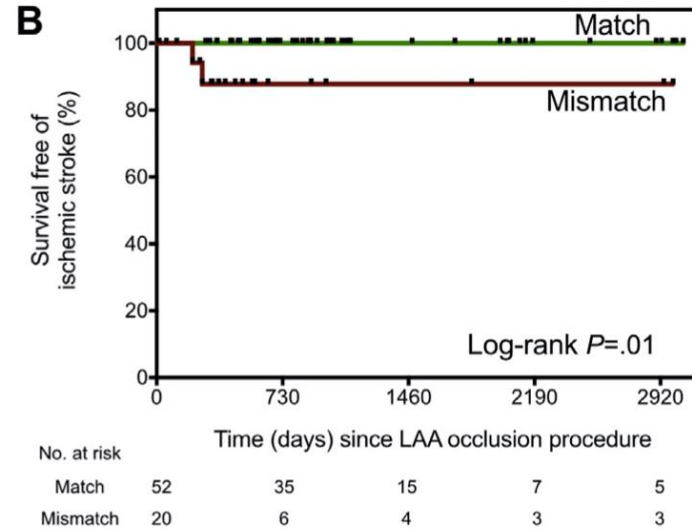
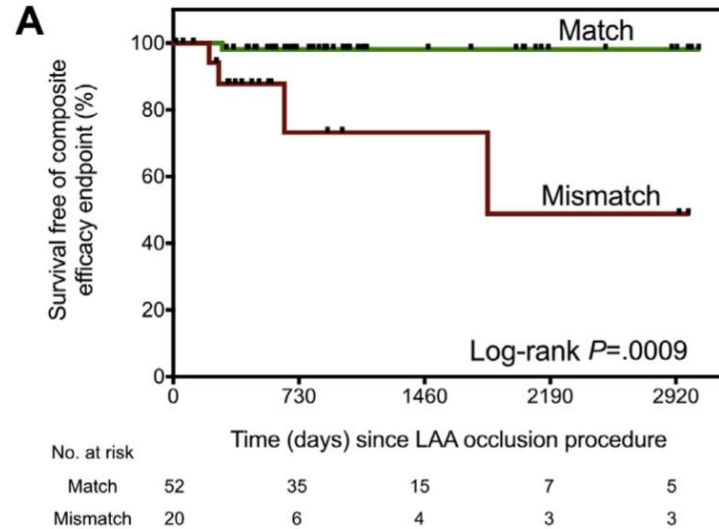


**Table 6** Comparison of procedural events and follow-up device problems between retrospective and prospective cohorts

Variable	Retrospective cohort	Prospective cohort	<i>P</i>
Procedure time (min), median (range)	60 (25–150)	41 (30–55)	<.0001
Implant success	67/72 (93.1)	32/32 (100.0)	.32
Device used per procedure, mean (range)	1.3 (1–4)	1.1 (1–2)	.046
Composite procedural major safety events within 7 days	6/72 (8.3)	0/32 (0.0)	.17
Serious pericardial effusion	5/72 (6.9)	0/32 (0.0)	.32
Air embolism	1/72 (1.4)	0/32 (0.0)	≥.999
Device complications/problems on follow-up TEE imaging			
Device thrombus	4/64 (6.3)	0/32 (0.0)	.30
Peridevice leak			.015
None	44/64 (64.1)	31/32 (96.9)	
<1 mm	1/64 (1.6)	0/32 (0.0)	
1–3 mm	17/64 (25.6)	1/32 (3.1)	
>3–5 mm	4/64 (6.3)	0/32 (0.0)	
>5 mm	1/64 (1.6)	0/32 (0.0)	

Data expressed as number/total (percentage) except as indicated.

Better event-free survival in patients with model-match sizing LAA device



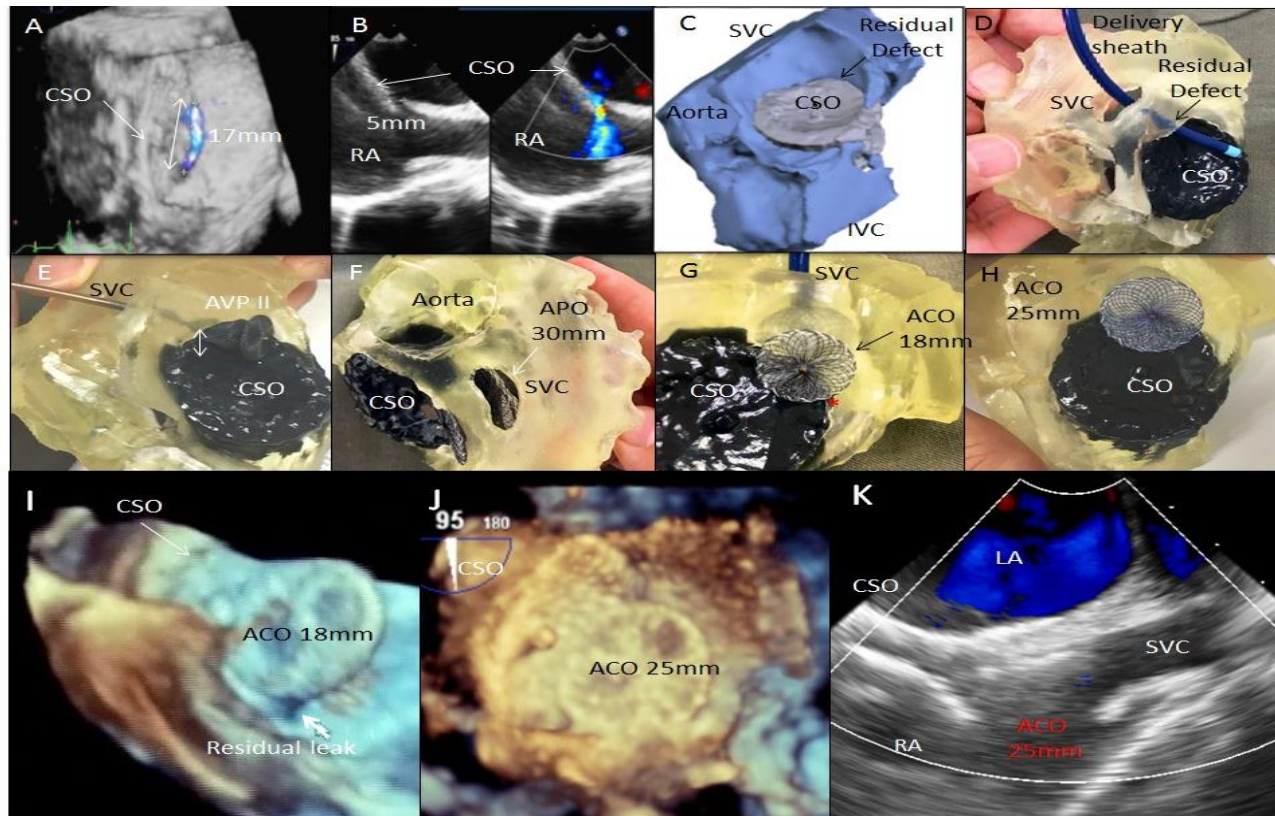


# JACC

## Cardiovascular Interventions

### Using Multimaterial 3-Dimensional Printing for Personalized Planning of Complex Structural Heart Disease Intervention

Kent Chak-Yu So, MBChB,<sup>a</sup> Yiting Fan, MM,<sup>a</sup> Louis Sze, MSc,<sup>b</sup> Ka-wai Kwok, PhD,<sup>c</sup> Anna Kin-yin Chan, MBChB,<sup>a</sup> Gary Shing-Him Cheung, MBBS,<sup>a</sup> Alex Pui-Wai Lee, MD<sup>a</sup>



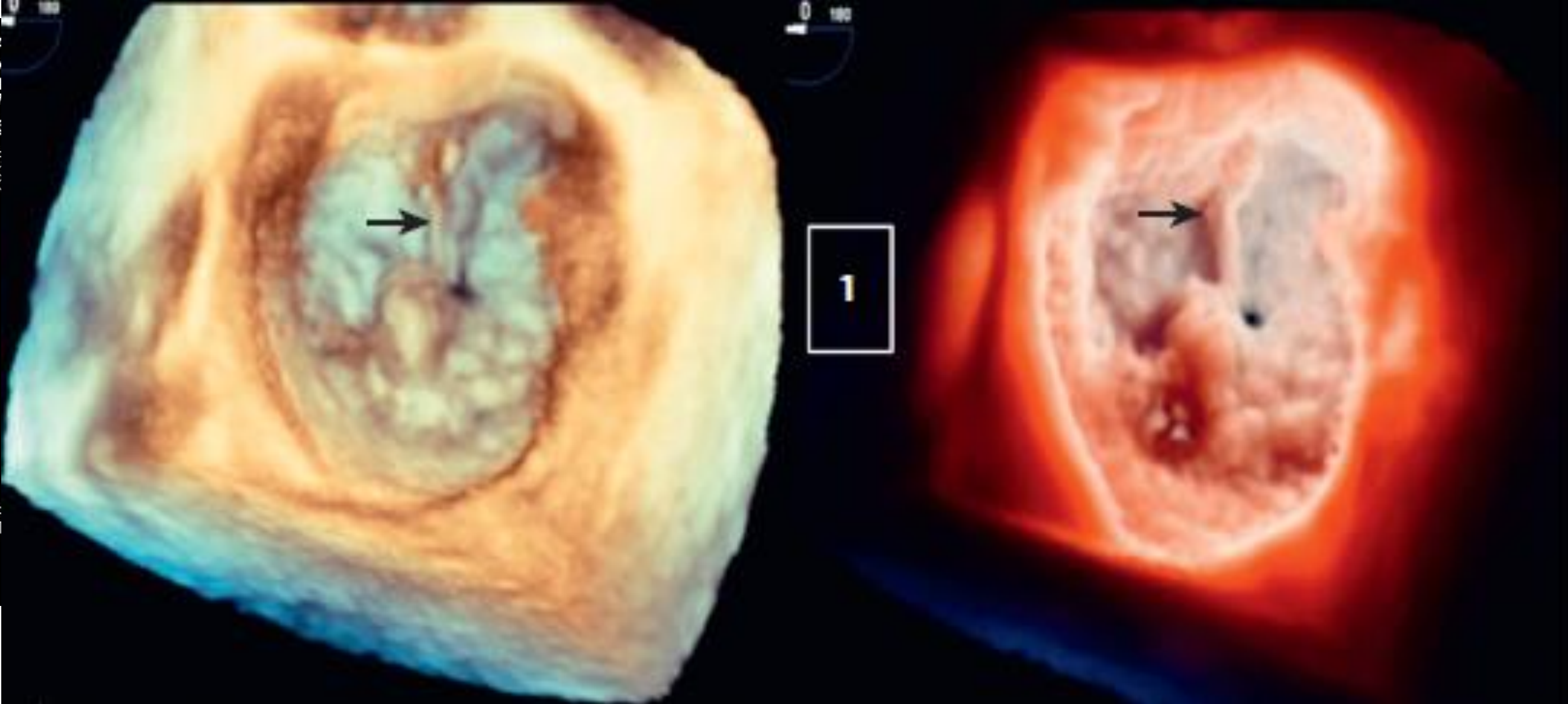
# Be Photo-realistic

Light source, surface texture, reflectivity

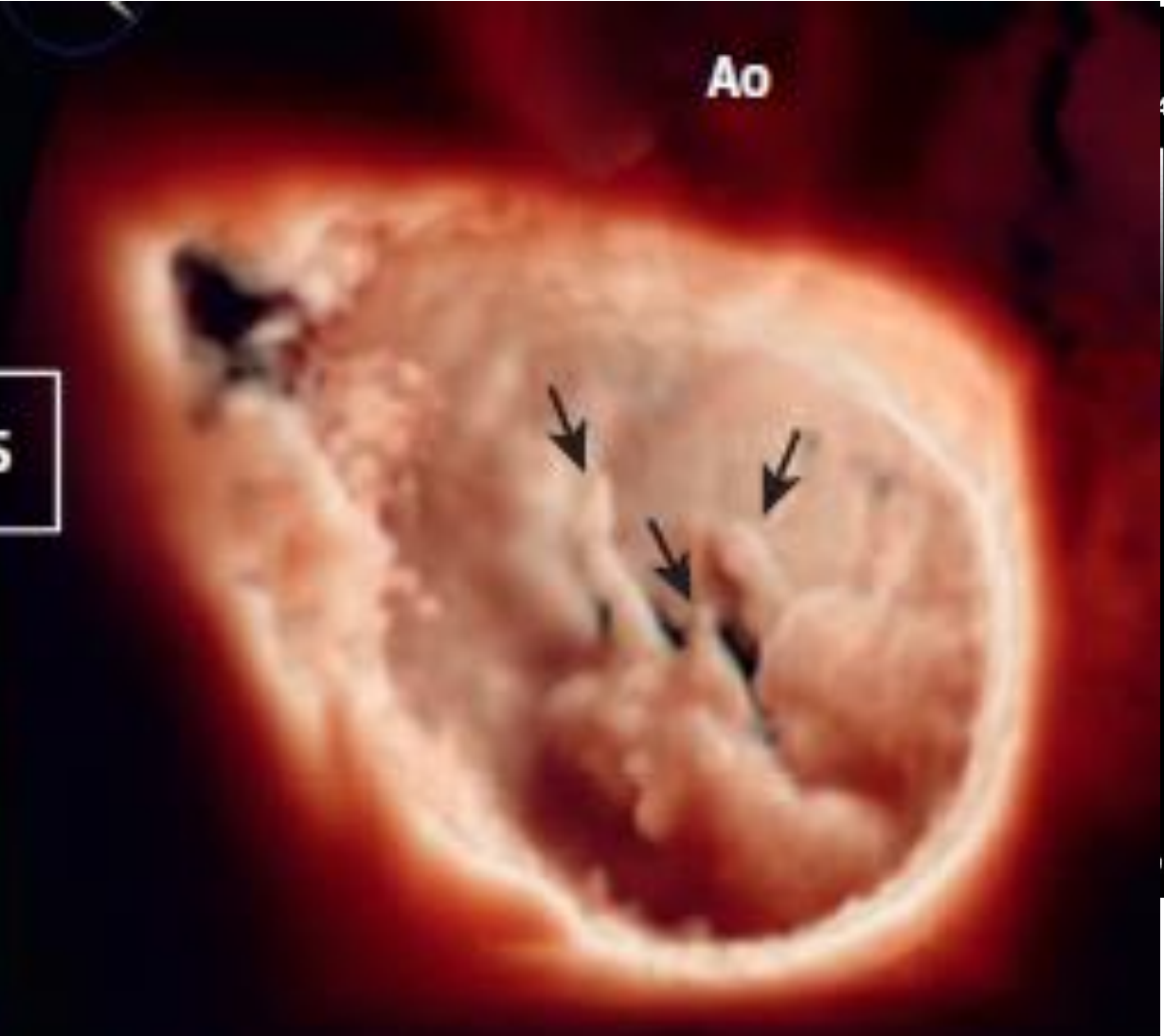




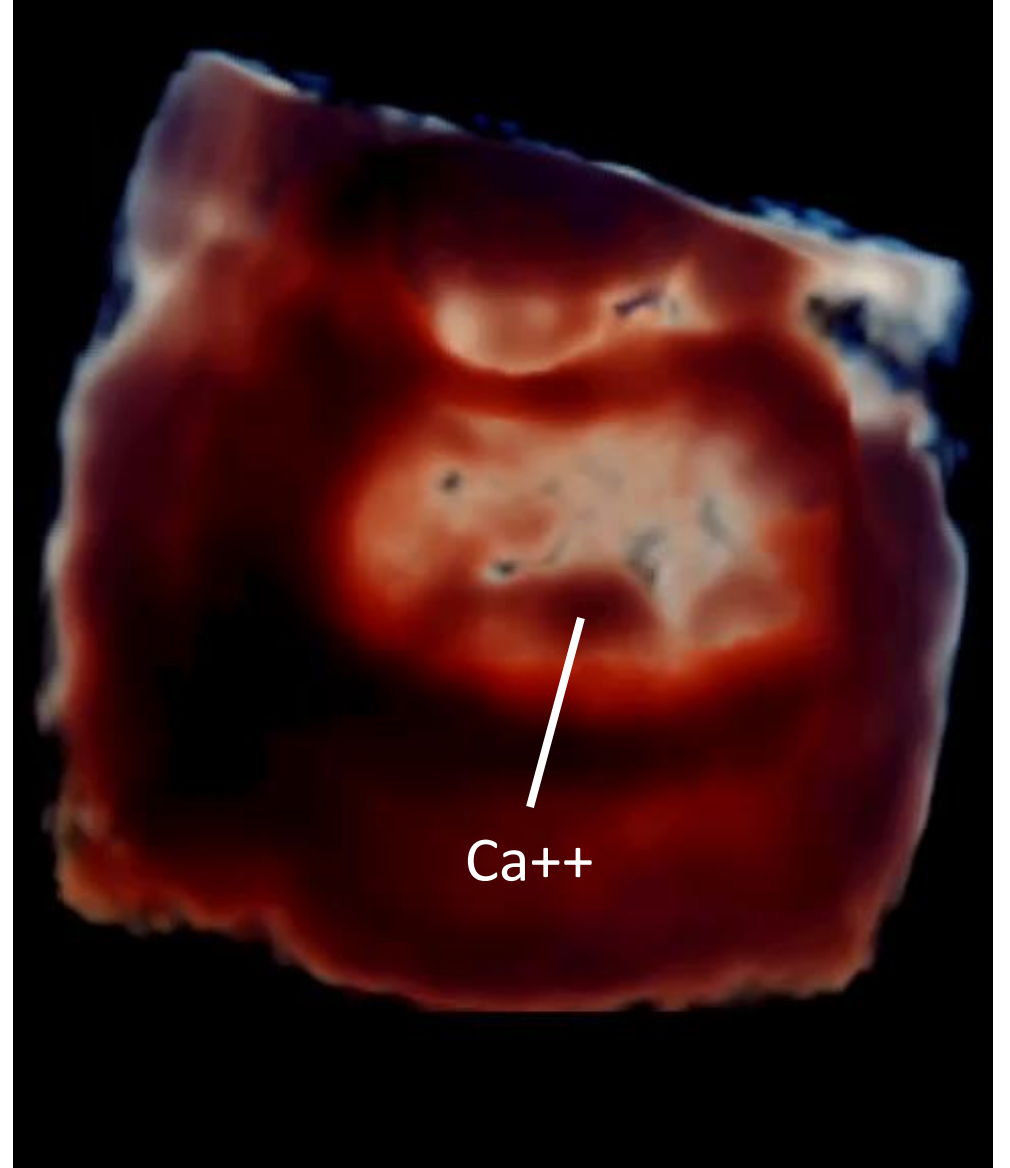
# MV Flail

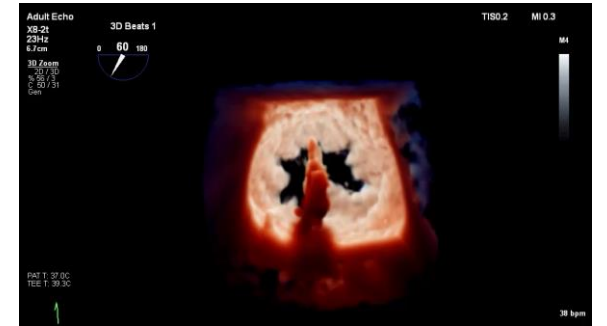
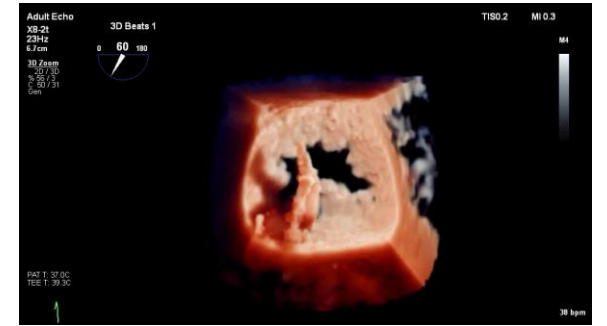
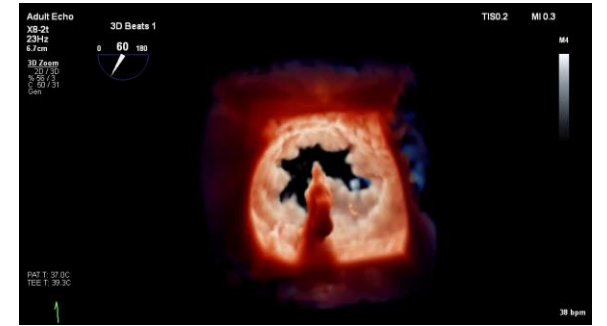
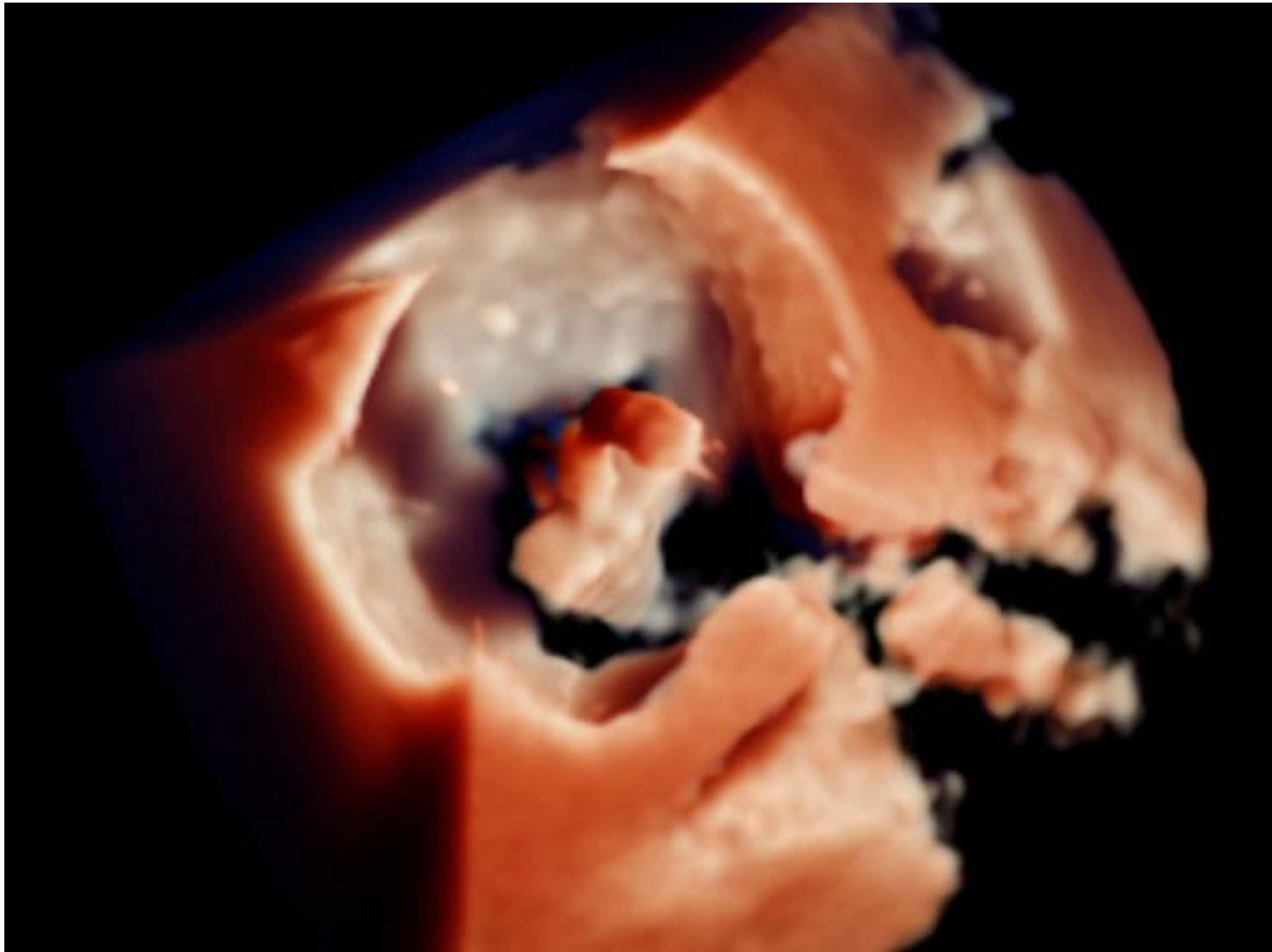


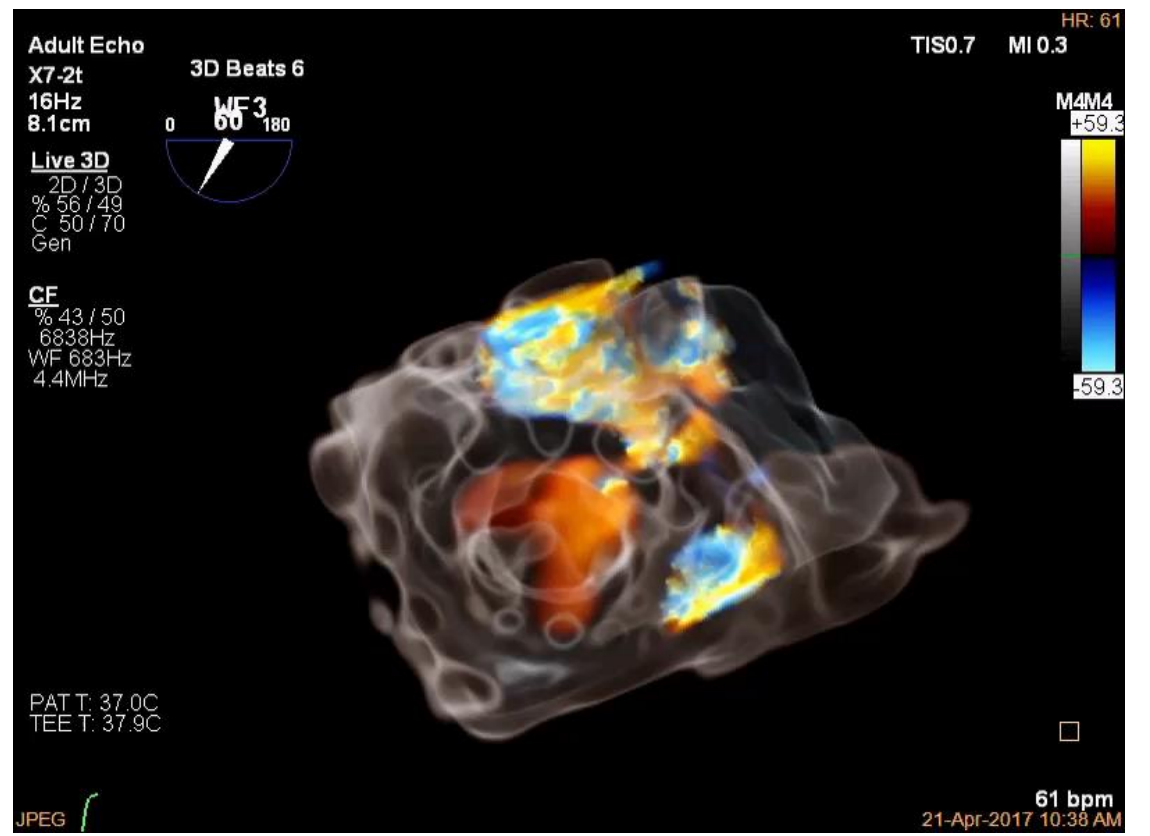
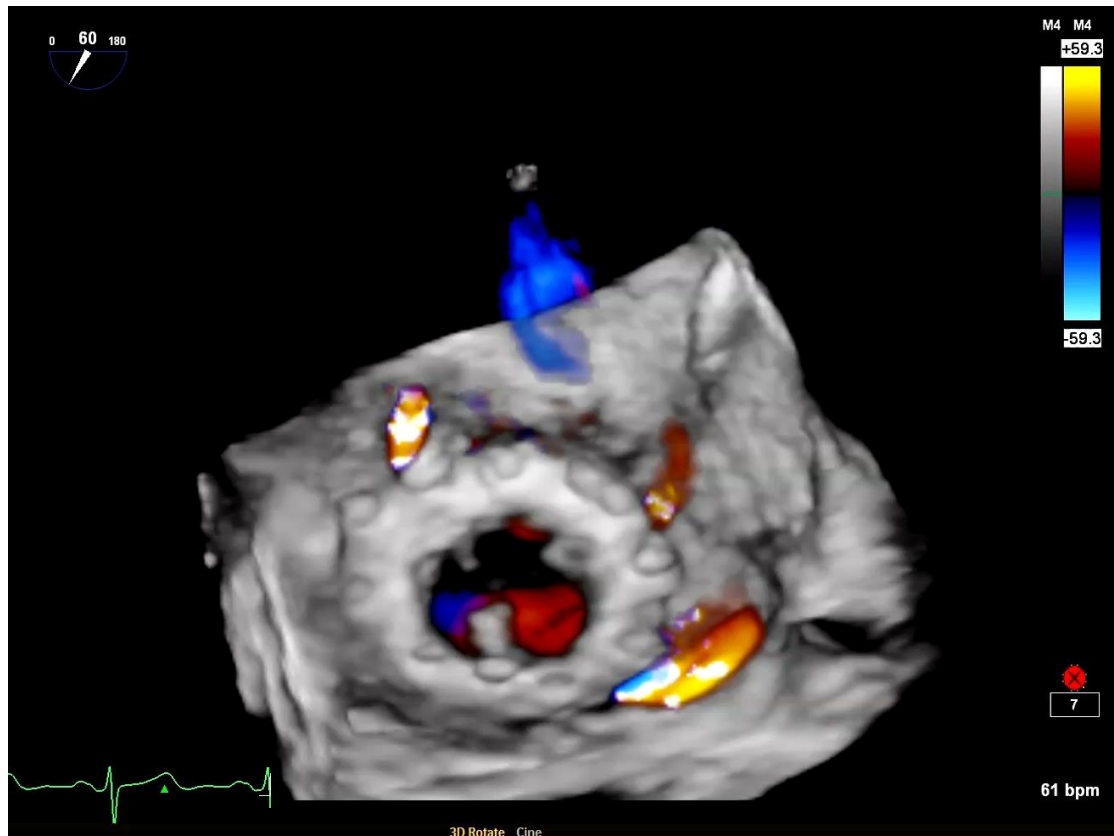
# Ruptured MV Chordae











Free Form

TIS0.2

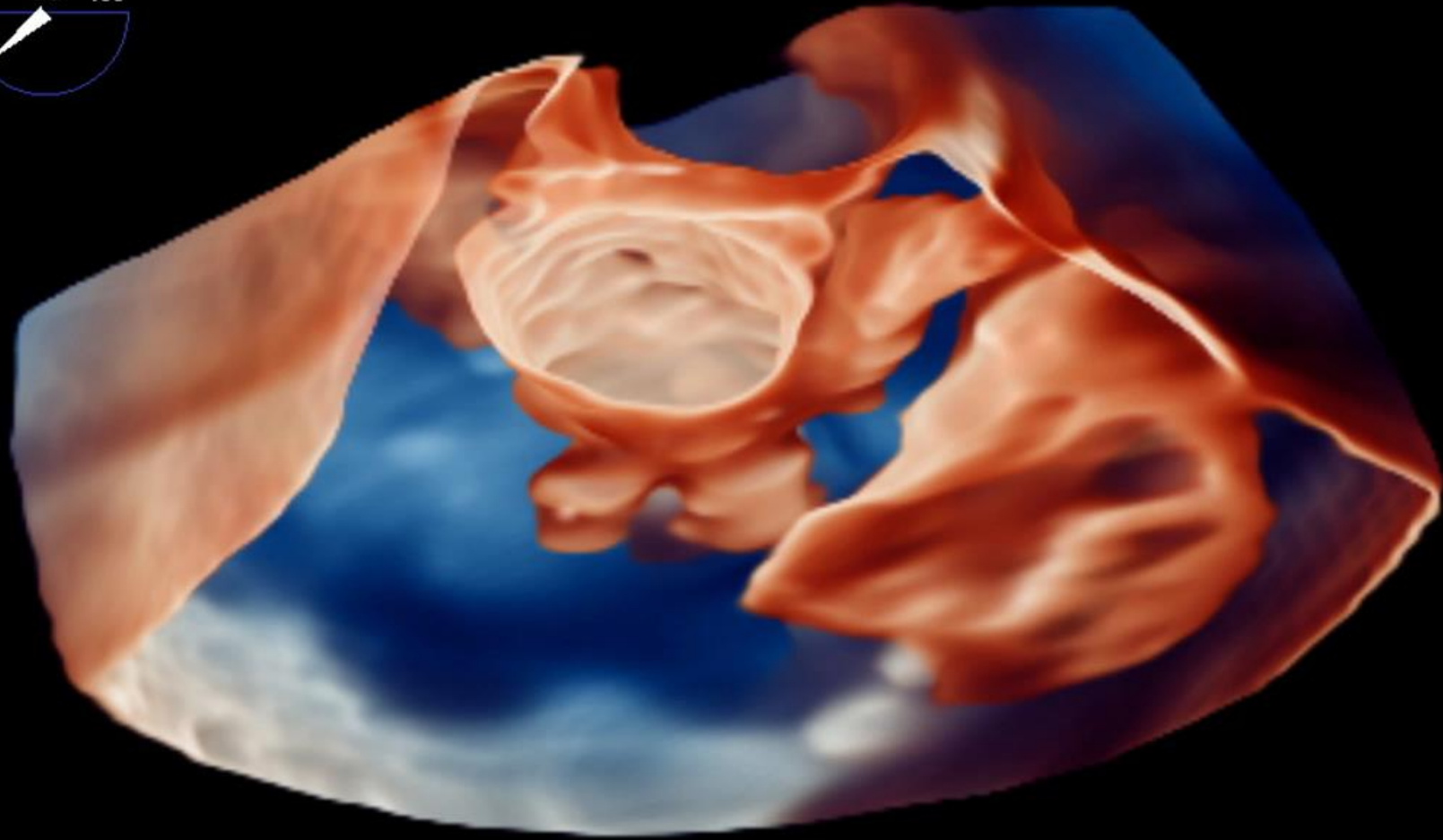
Frame 1/18  
MI 0.3  
52 BPM

X8-2t  
15Hz  
6.5cm

3D Beats 1



3D Zoom  
2D / 3D  
% 67 / 45  
C 50 / 30  
Gen  
XRES 2



PAT T: 37.0C  
TEE T: 39.5C

52 bpm  
10-Sep-2019/14:35:26



[www.echoasia2020hk.org](http://www.echoasia2020hk.org)

# ECHO ASIA

## 2020

28-30 May 2021 Hong Kong



AAE

Asian-Pacific Association  
of Echocardiography



Thank you!

