



# **Ruolo della TC nella valutazione pre e post impianto**

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Chiusura percutanea dell'auricola sinistra: dalle linee guida alla pratica clinica.

*Torino 8 Maggio 2018*

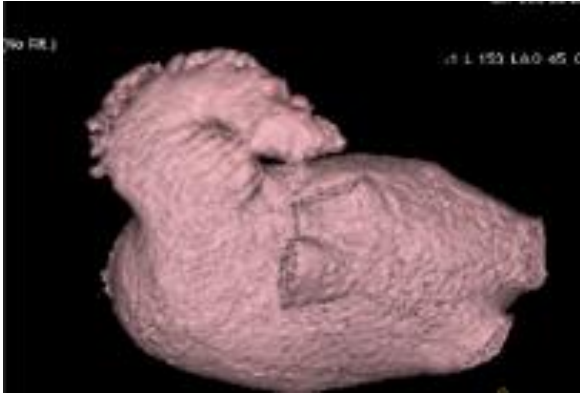
# Left atrial appendage (LAA) Anatomy

- Highly variable structure (size and shape)
- Orifice is usually elliptical (not round)
- Lies in more than 1 imaging plane
- 80% multi-lobed

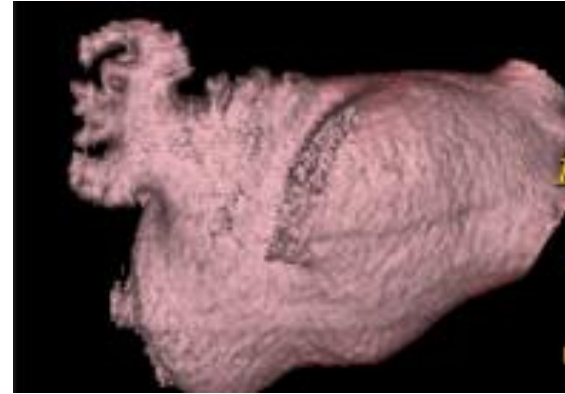


# 1) Assessment of shape and morphology

## LAA Shape



**The Chicken Wing Type** LAA is an anatomy whose main feature is a sharp bend in the dominant lobe at some distance from the LAA ostium



**The Broccoli Type LAA** is an anatomy whose main feature is an LAA that has limited overall length with more complex internal characteristics

# Chicken wing

Sharp bend in dominant lobe



More complex LAA occlusion

# Cauliflower

Limited length and more complex internal characteristics



Higher risk of stroke

# 1) Assessment of shape and morphology

## LAA position

High, middle or low on the Left Atrium

## LAA Orientation

Posterior or anterior facing



## 2) Assessment of LAA thrombus presence



Early enhanced phase



Late enhanced phase

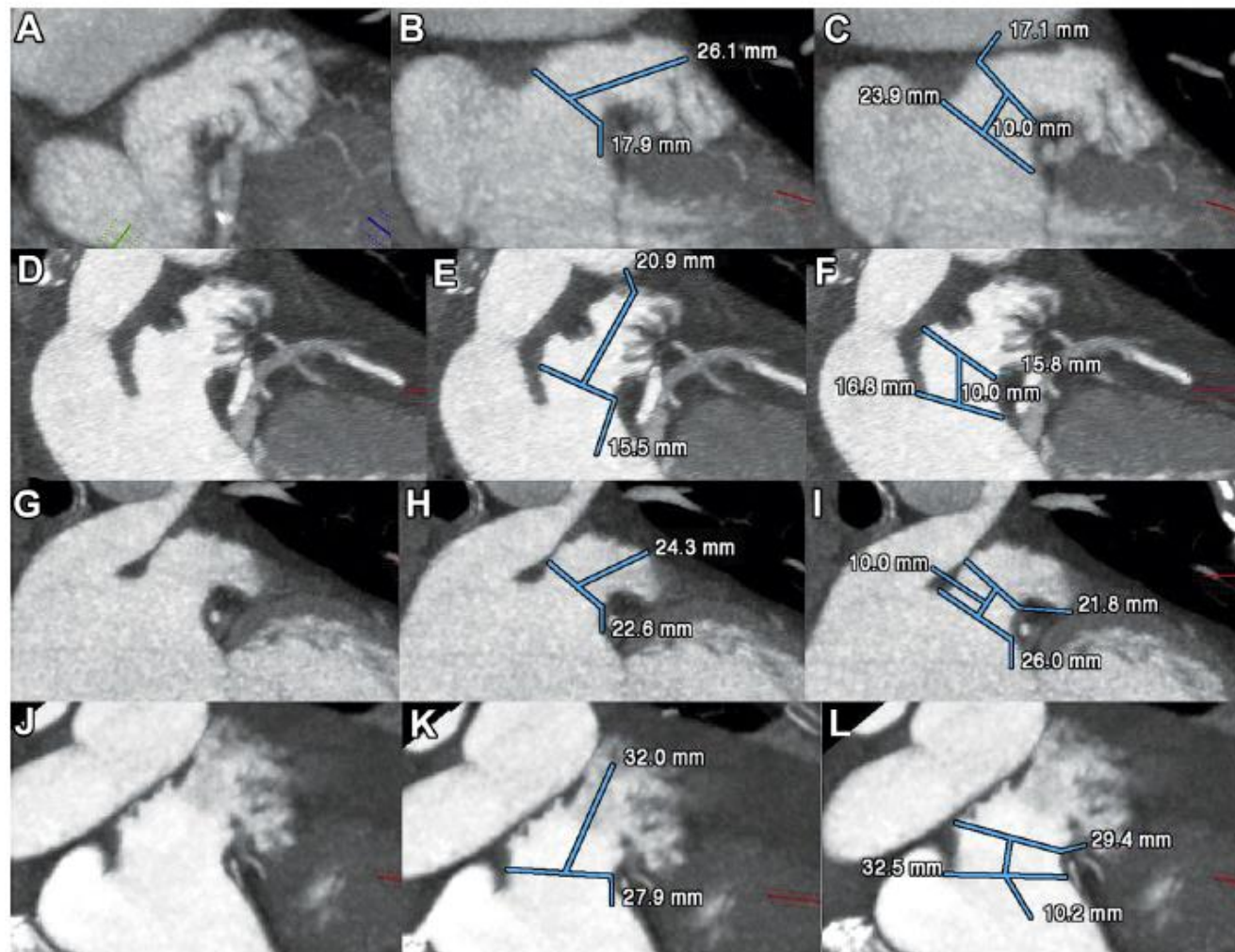


### 3) LAA Sizing

- Identify and size the landing zone and main lobe depth

Max LAA ostium size should be  $\geq 11$  mm and  $< 31$  mm (Amulet)

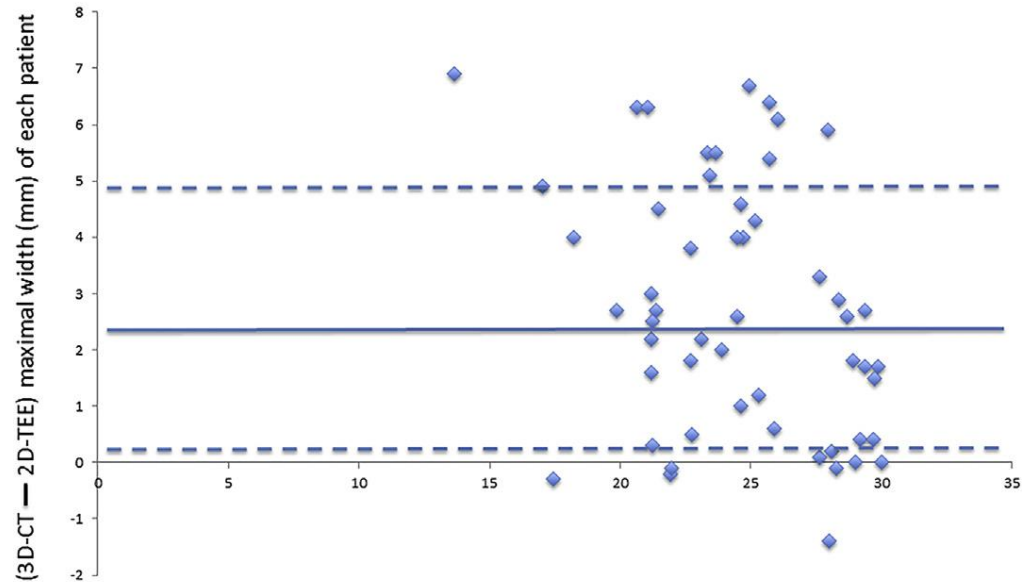
LAA length should be equal to or greater (Watchman) and 10-12 mm (Amulet)



# 3) Sizing

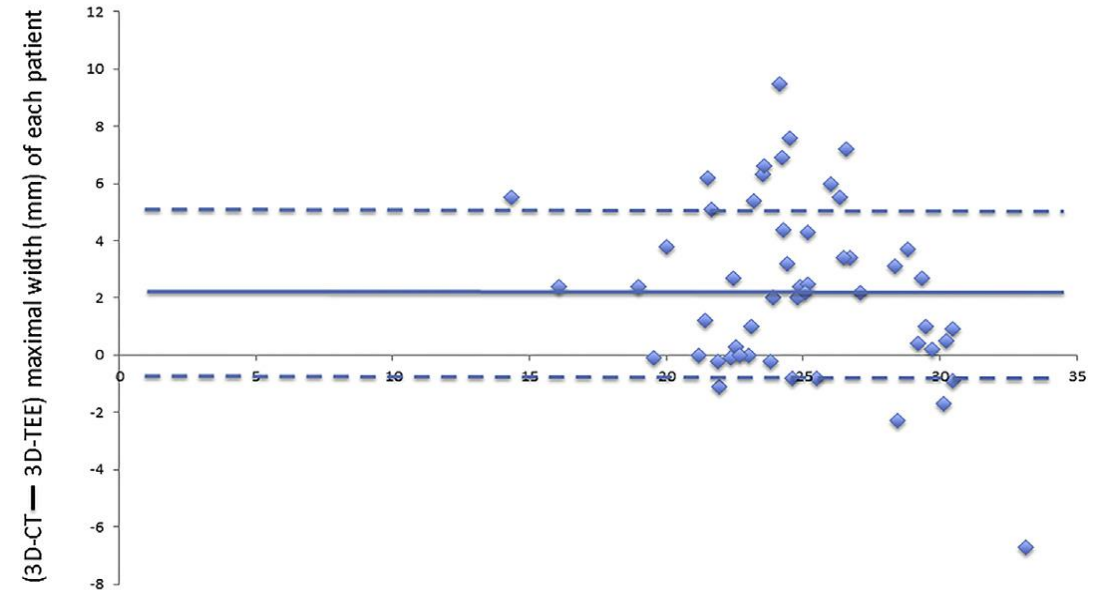
## Comparison between CT scan and 2D/3D TEE

Mean difference between 3D-CT and 2D-TEE maximal LAA width  $2.7 \pm 2.2$  mm



Mean (3D-CT — 2D-TEE) maximal width (mm) of each patient

Mean difference between 3D-CT and 3D-TEE maximal LAA width  $2.3 \pm 3.0$  mm



Mean (3D-CT — 3D-TEE) maximal width (mm) of each patient



# 3) Sizing

## Comparison between CT scan and 2D/3D TEE

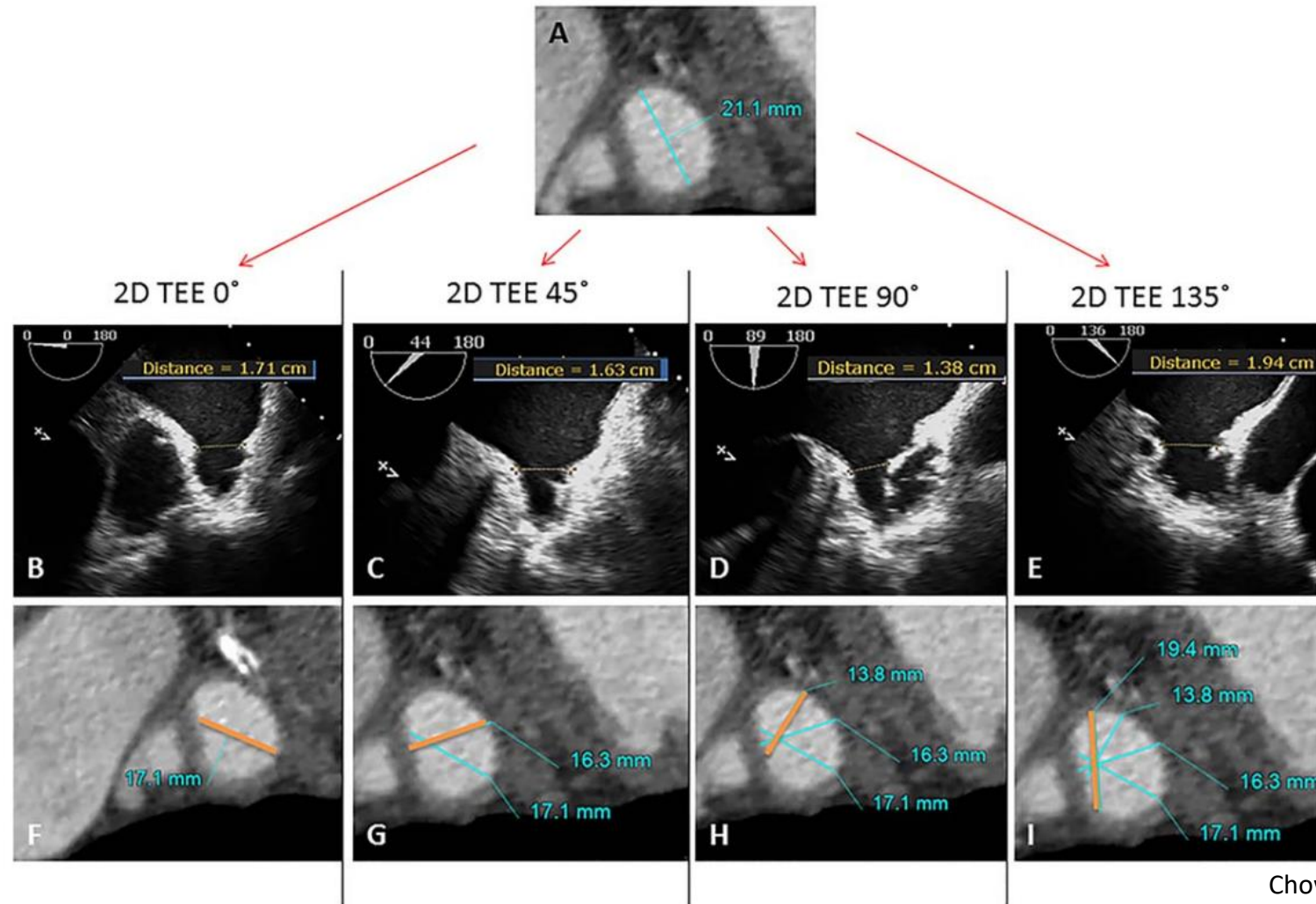
24 patients prospectively randomized to undergo LAAO planning using either TEE or 3D-CT.

	CT N= 12	TEE N=12	P-value
Succesfull implantation	12 (100%)	11 (92%)	1.0
Access to device release time (min)	47 ± 16	67 ± 24	0.03
Total procedural time (min)	55 ± 17	73 ± 24	0.05
Devices used	1.3 ± 0.7	2.5 ± 1.2	0.01
Contrast (ml)	63 ± 33	79 ± 28	0.27
Fluoroscopy time (min)	19.8 ± 7.7	25.3 ± 10.8	0.07
Major adverse events	0	1 (8.3%)	1.0
Perforation	0	0	
MI	0	0	
Death	0	0	
Stroke	0	1 (8.3%)	

The mean difference between 3D-CT and 2D-TEE for widest LAA dimension was **2.2 ± 1.8 mm**

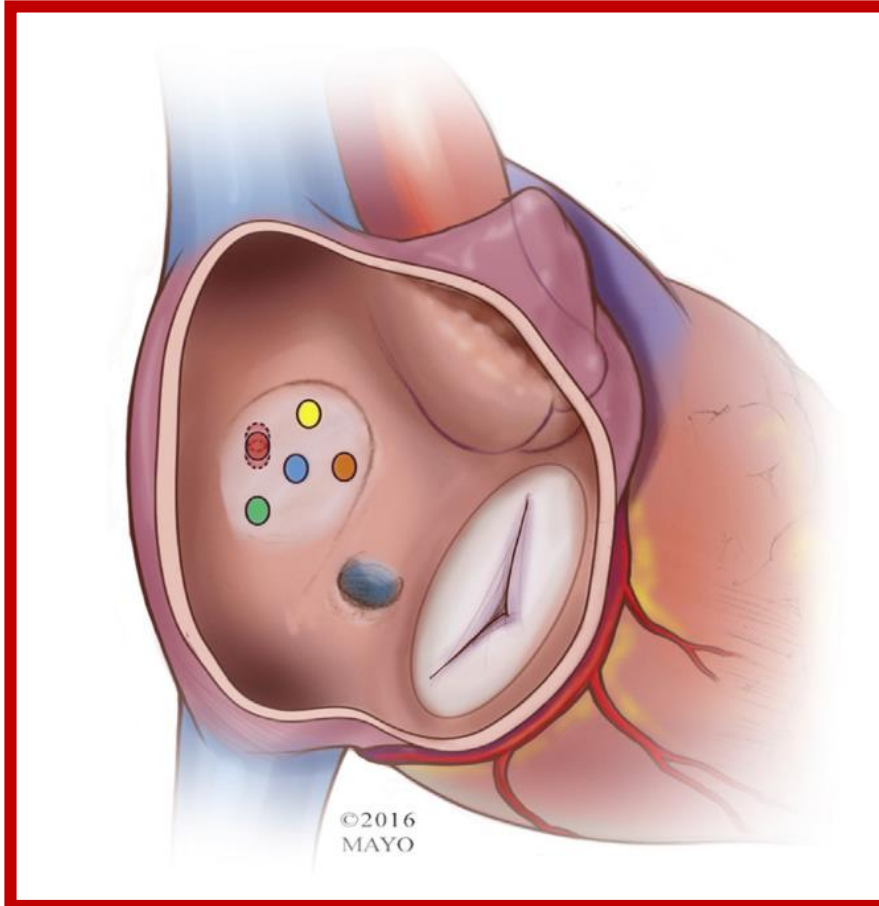
### 3) Sizing

## Comparison between CT scan and 2D/3D TEE



# 4) Assessment of atrial septal anatomy

Looking for  
ASD  
PFO  
septum lipomatosis



- Transseptal PFO closure
- Paravalue leak closure  
(higher crossing site for medial leaks; lower site for lateral leaks)
- LVAD placement
- Hemodynamic studies
- LA-appendage closure
- Pulmonary vein interventions

## 5) Case planning

- Identify septal puncture site
- Generate fluoroscopic view
- 3D printing

# CT scan analysis




Report Details			
Creation Date:	31/05/2016	Physician:	Pr Splauding Dr Otmani
Created By:		Hospital:	HEGP
Received Date:		City:	Paris
Reviewed Date:		Country:	

Patient Information			
Name:	MON, B	Height:	m
Sex:	Male	Weight:	kg
Year Of Birth (Age):	1944 (72)	BMI:	
NYHA:		Euro Score:	
Comments:			

LAA	
Comments:	Ostium : 22mm Landing zone : 16mm Amulet 20mm

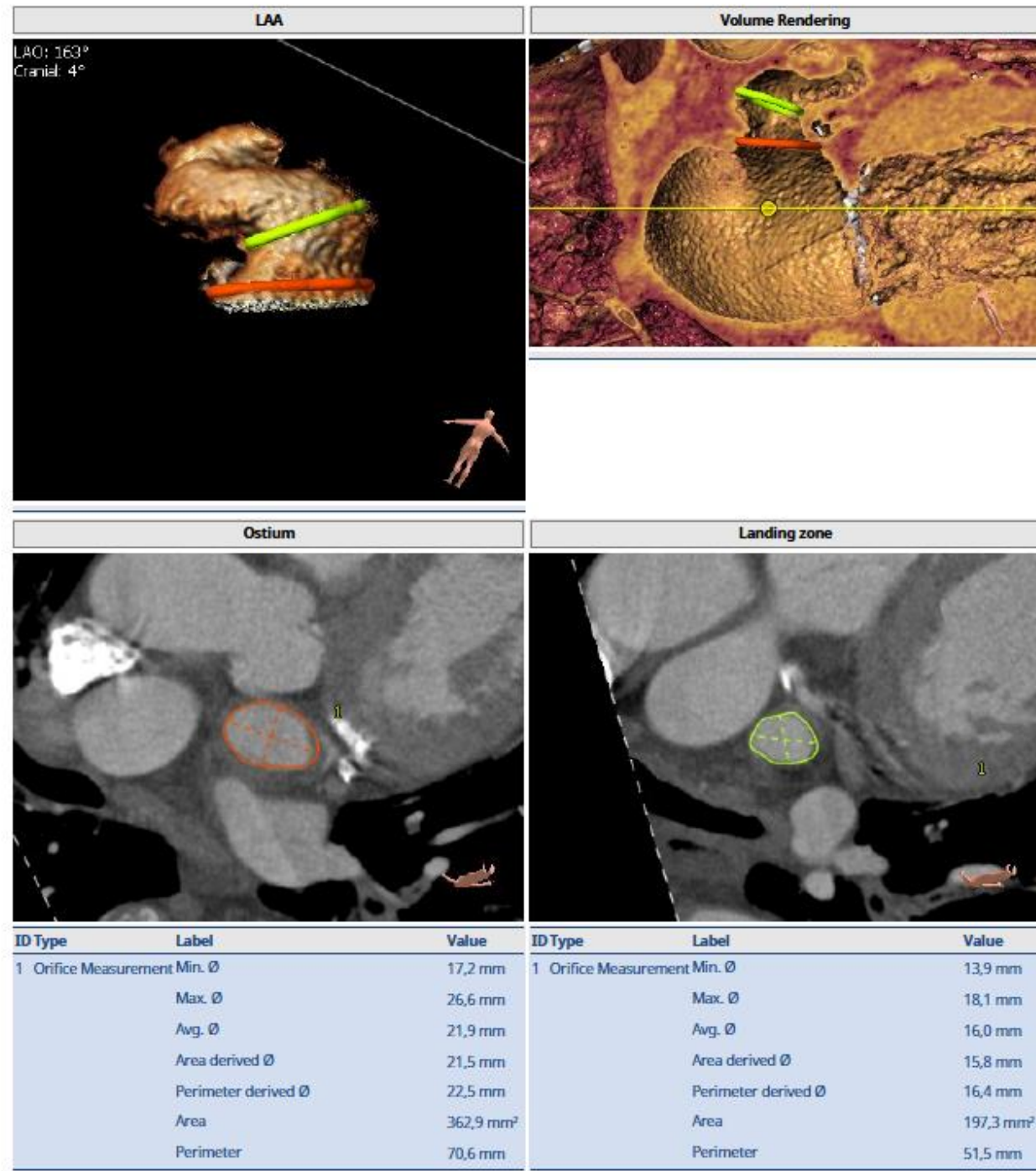
Conclusion	
Conclusion:	Implantation d'une Amulet de 20 mm 9-ACP2-007-020 lot 5259024 Gaine 12F : 9-TV45X45-12F-100 lot 5402083

Screenshots	
Segmentation only	LAA
RAO: 147° Cranial: 44° 	LAO: 144° Cranial: 3° 

# MPR and intra cardiac view

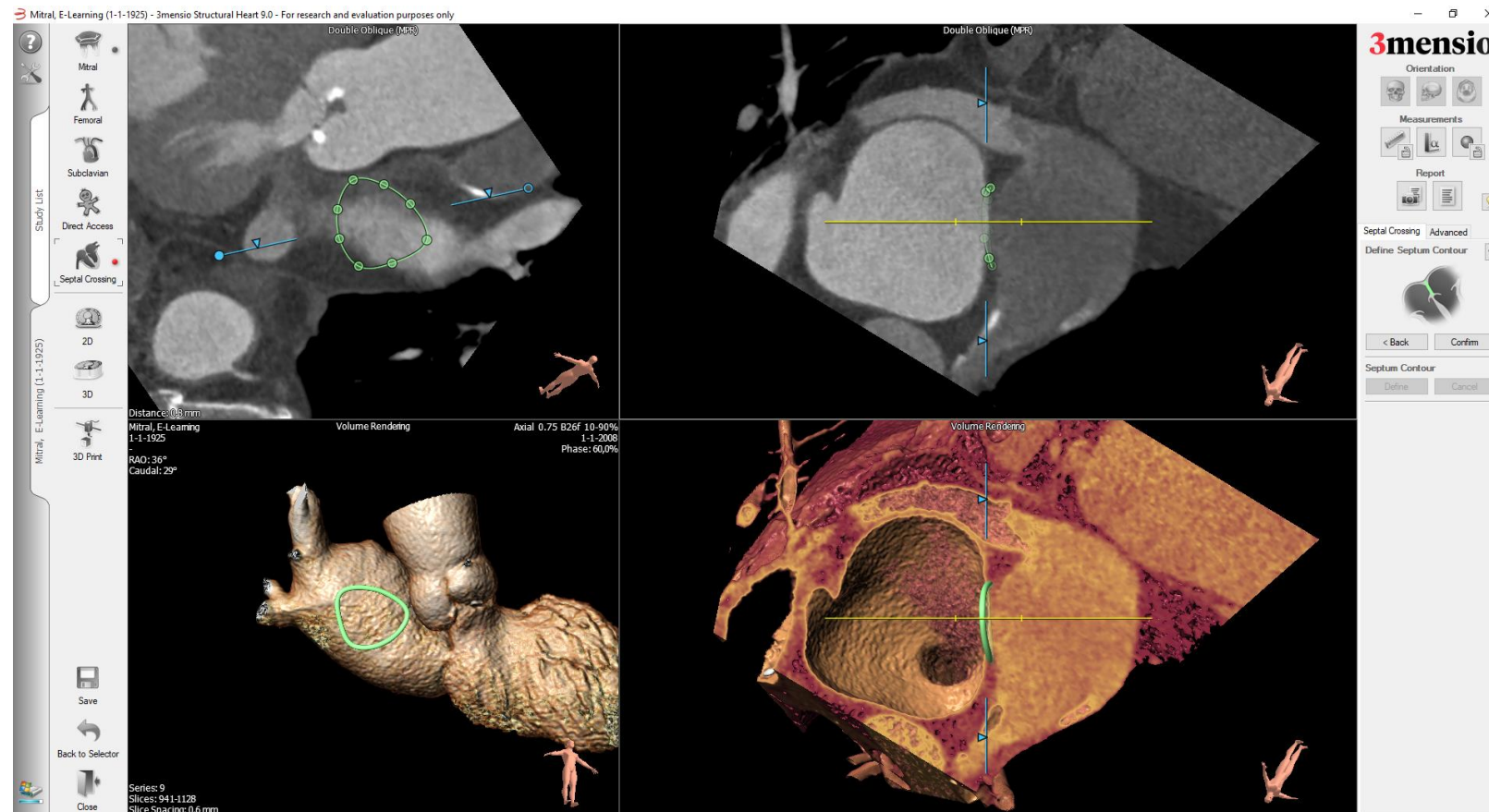
- ✓ Assess the landing zone
- ✓ LAA lobes
- ✓ Surround structures

- Mitral Valve
- Pulmonary Ridge

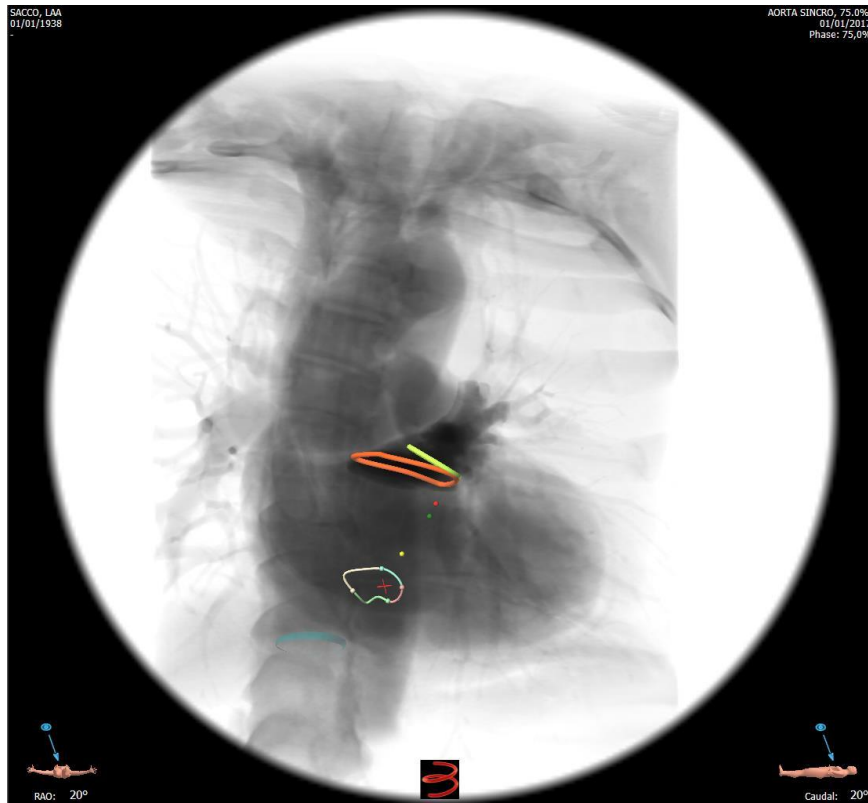




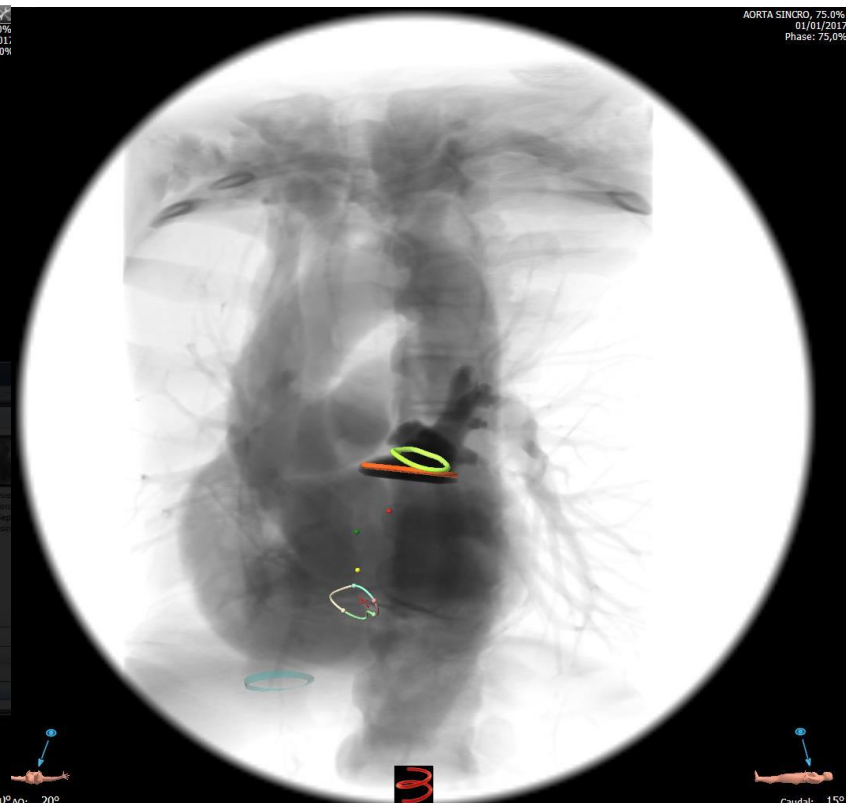
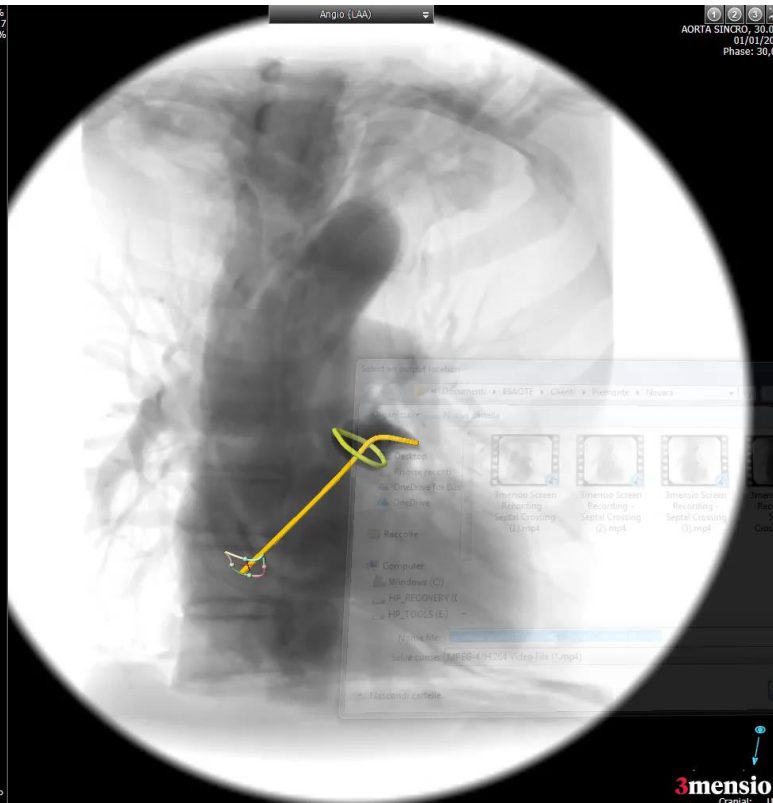
# Identify septal puncture site



# Generate fluoroscopic view & Find optimal projection



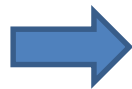
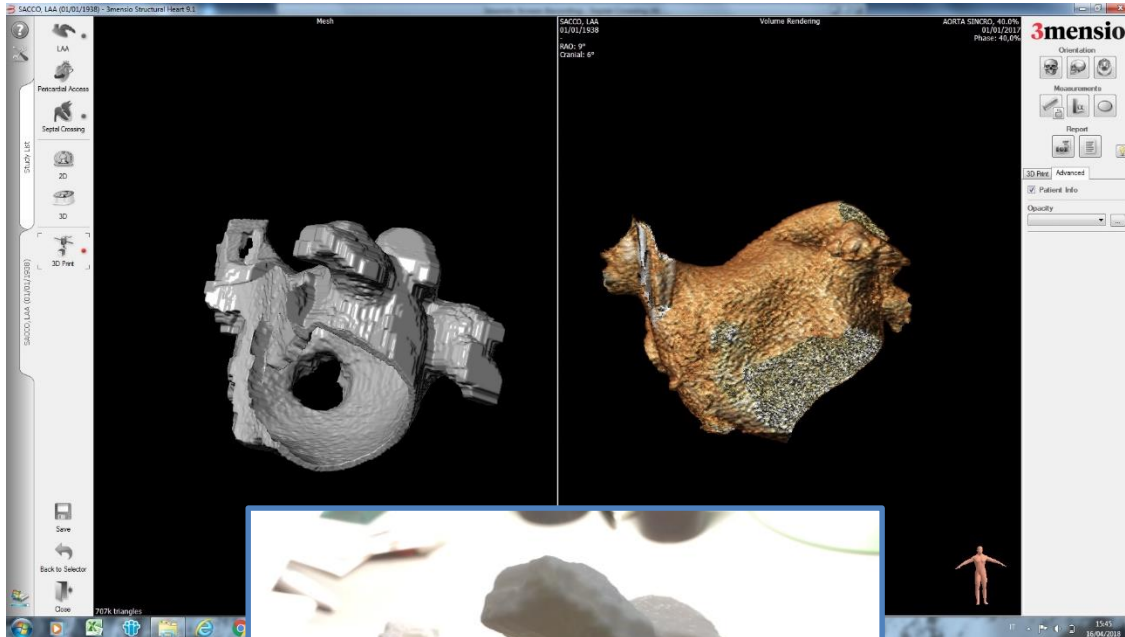
RAO 20° CAUD 20°



LAO 20° CAUD 15°

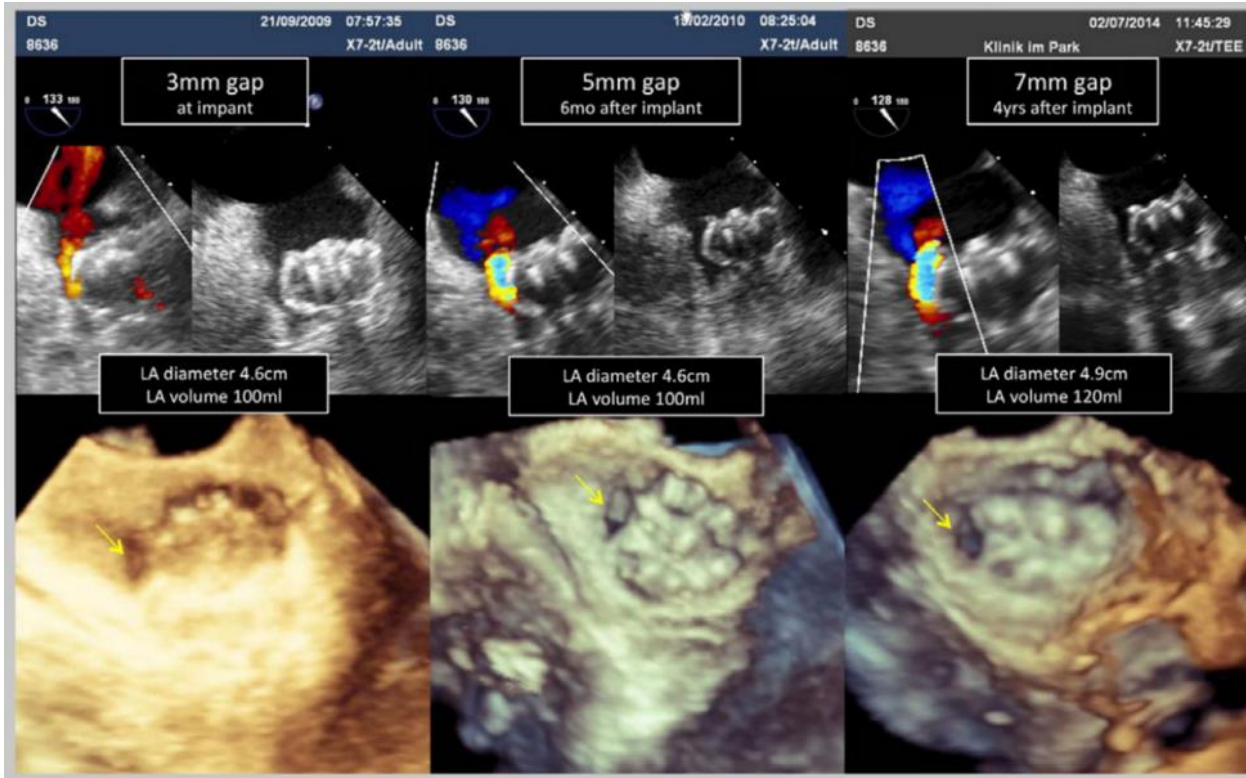
# 3D printing

Pt-tailored bench test for device sizing  
Bench simulation of catheter and device position (coaxiality between septum and LAA)





## 5) Follow-up



- TEE and MDCT in detection of a LAA thrombus have similar sensitivity. (1,2)
- A substudy of the PROTECT-AF trial showed a peridevice gap of  $\leq 5$  mm in 32% of patients, not associated with an increased risk of thromboembolism. (3)
- Using TEE and MDCT at 3 months to evaluate peridevice gap after ACP implantation resulted in gap underdetection using TEE. (4)

1. Homsy et al. Rofo. 2016;188:45–52.
2. Budoff et al. Am J Cardiol. 2014;113:173–177.
3. Viles-Gonzalez et al. JACC 2012;59:923–929.
4. Jaguszewski et al. Catheter Cardiovasc Interv. 2015;85:306–312.

# Conclusions

The role of CT scan pre-implantation of LAA occluder is central.

- Clinical/Anatomic informations
- Procedural planning
- Prevention of complications

The role of CT scan post-implantation may be alternative to echo TEE or complementary if TEE is inconclusive.

Thanks!





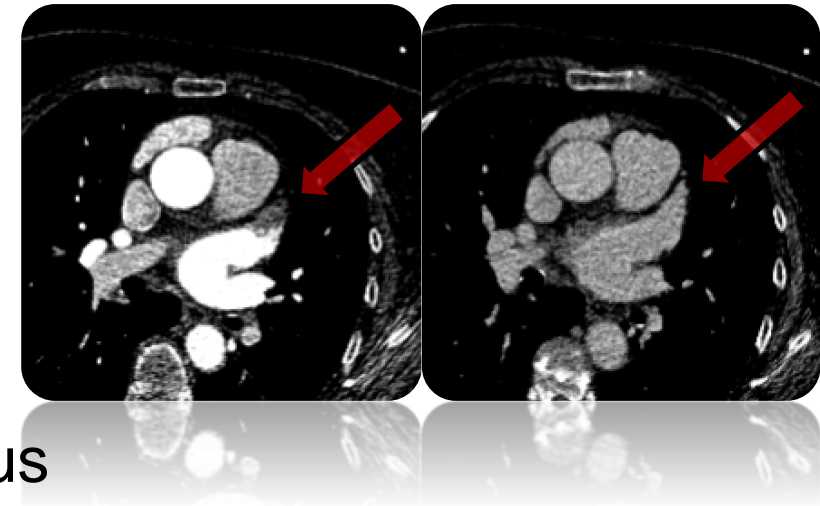


# CT Protocol

## ***Image Quality is key***

*Acquiring high qualitative CT images is an 'art'*

- ✓ Contrast enhanced CT of the heart (CCTA)
- ✓ ECG-gated (HR as low as possible!!)
- ✓ Preferably submillimeter slices
- ✓ Time the scan for the LAA
- ✓ Different protocols used for LAA:
  - Multiphase or single phase
  - Late enhanced phase for ruling out thrombus



# Why CT for planning and sizing?

## Current limitations of LAA imaging with TEE

- ✓ Difficult to get a full 3D overview of the LAA and surrounding structures
- ✓ Variability of measurements
  - Inter-operator variability
  - Inter-patient variability
- ✓ Discomfort for the patient
  - Either LAA procedure under GA
  - Either swallowing the tube
- ✓ Experienced operator needed ie availability
- ✓ Time consuming

# Why CT for planning and sizing?

## **Disadvantages of using CT images**

- ✓ Radiation:  $<5\text{mSv}$  in prospective acquisition
- ✓ Use of contrast agent
- ✓ Reimbursement?

# What is 3mensio - LAA

## ✓ **Start to end product**

- Local database with PACS connectivity
- Dedicated workflows
- Reporting tool (iPad reports)

## ✓ **Pre-procedural planning for LAAO**

### ✓ LAA workflow

- 3D volume rendering of the LAA
- Measurement of the LAA
- Relationship with surrounding structures

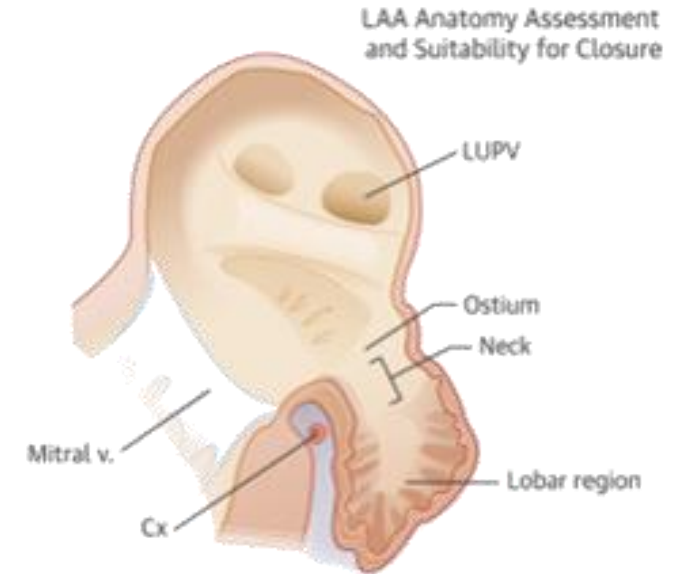
### ✓ Approach Route assessment

- Visualize the intra atrial septum and the LAA



# Information present in the CT

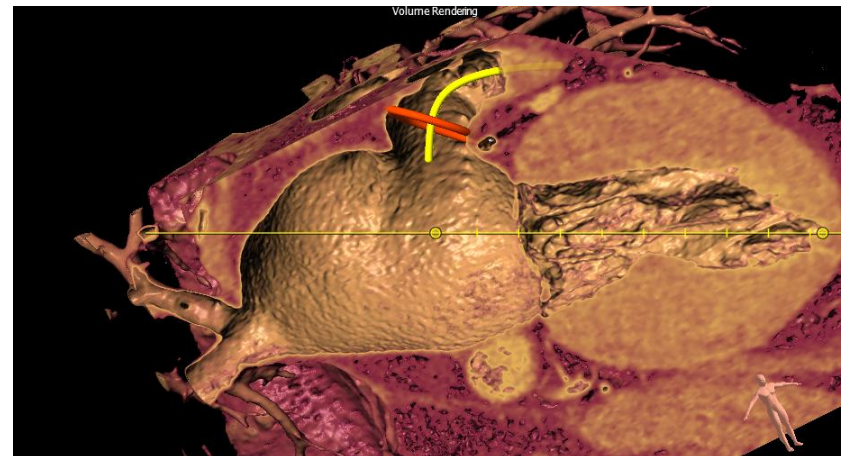
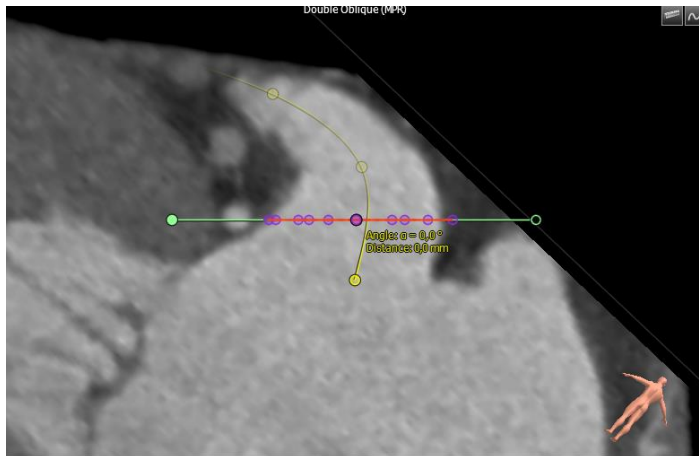
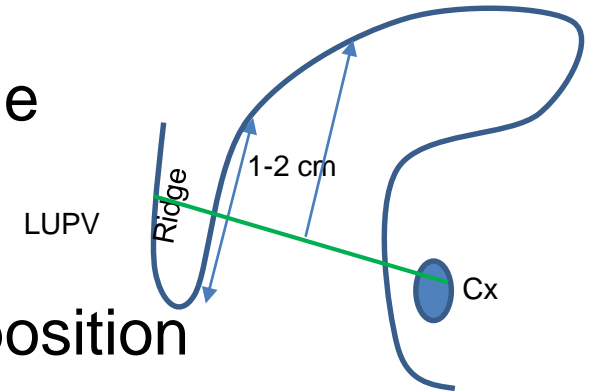
- ✓ LAA anatomy
  - ✓ Shape
  - ✓ Position and orientation
  - ✓ Relationship with surrounding structures
- ✓ Landing zone measurement
- ✓ LAA working depth
- ✓ Optimal fluoroscopic projection angles
- ✓ Assessment Septal Crossing



# FAQ

## ✓How to plan for Watchman?

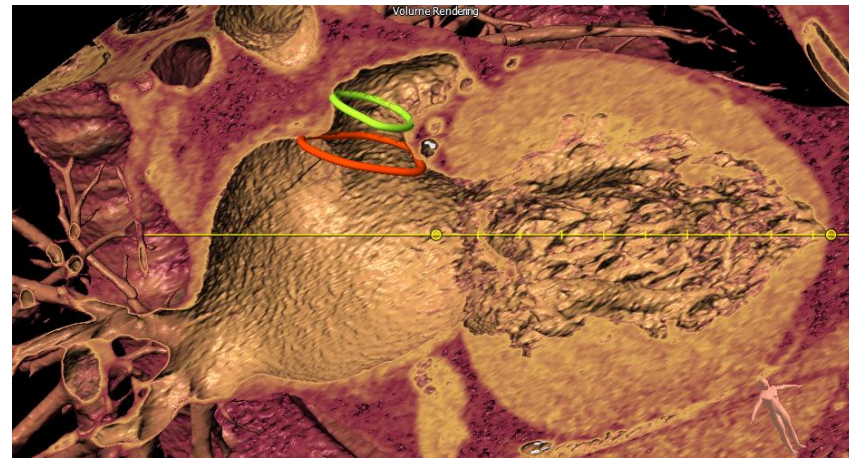
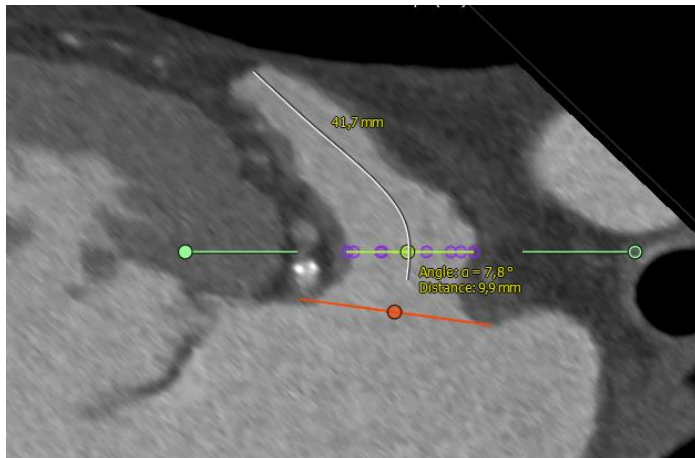
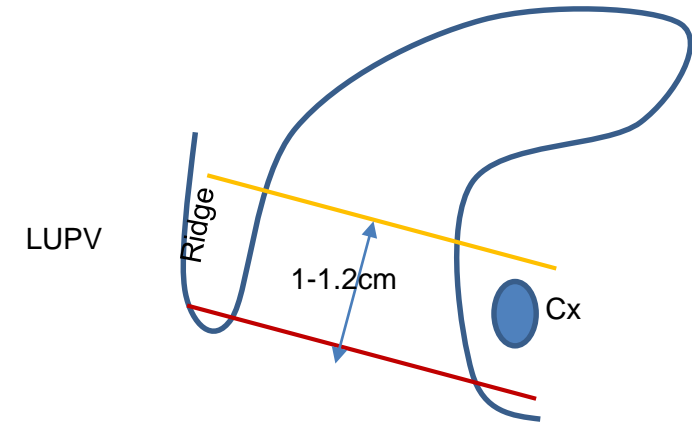
- Plane is defined by going from the circumflex to the pulmonary ridge
- Point along the ridge is 1-2 cm of the ostium
- Direction of the catheter is leading to finding this position
  - Centerline can be used to help find that direction



# FAQ

## ✓ How to plan for Amulet?

- Determine the ostium of the LAA
- Landing zone is 1-1.2 cm's distal
  - 1 cm in case of 16-22 mm device
  - 1.2 cm in case of 25-33 mm device



# Prevalence of Prior Stroke/TIA According to LAA Morphology

