

Heart Failure and Mitral Regurgitation

Imaging Assessment

Eustachio Agricola

Vita-Salute University

Head of Cardiovascular Imaging Unit

Cardio-Toracic-Vascular Department

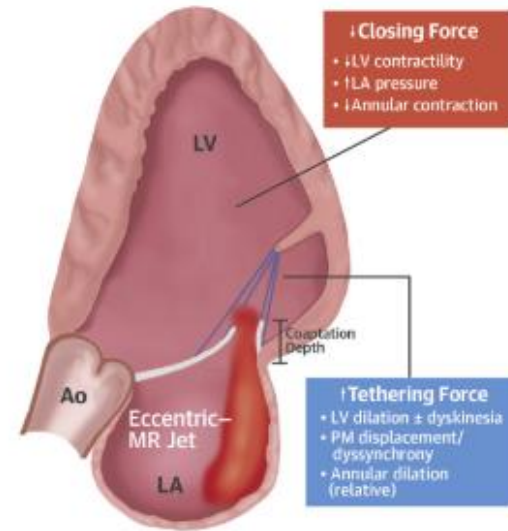
San Raffaele Hospital, Milan

Imaging Assessment: Goals

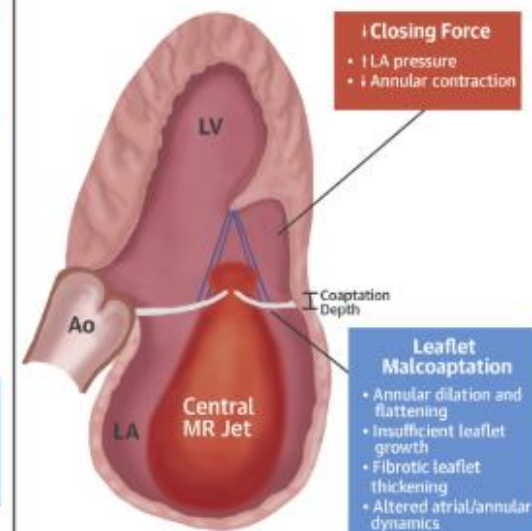
- **Mechanisms and classification**
- **MR quantification**
- **Dynamic component**
- **LV remodeling, function and mechanical dyssynchrony**
- **Functional Anatomy of MV:**
 - ✓ Leaflet and segment evaluation;
 - ✓ Leaflet motion
 - ✓ Annulus;
 - ✓ Calcium location;
 - ✓ Additional findings;
- **Surgical or percutaneous MV repair feasibility**
- **Predictions of potential intraoperative complications**

CENTRAL ILLUSTRATION Secondary Mitral Regurgitation Versus Atrial Functional Mitral Regurgitation

Secondary Mitral Regurgitation



Atrial Functional Mitral Regurgitation



Etiology and Prevalence

- 11%-59% post myocardial infarction
- >50% in dilated cardiomyopathy

Diagnosis

- Systolic LV dysfunction
- Restricted leaflet motion and tethering
- Eccentric jet > central jet
- Relative LA dilation

Management

- Optimal HF therapy
- Cardiac resynchronization therapy
- Revascularization
- MitraClip

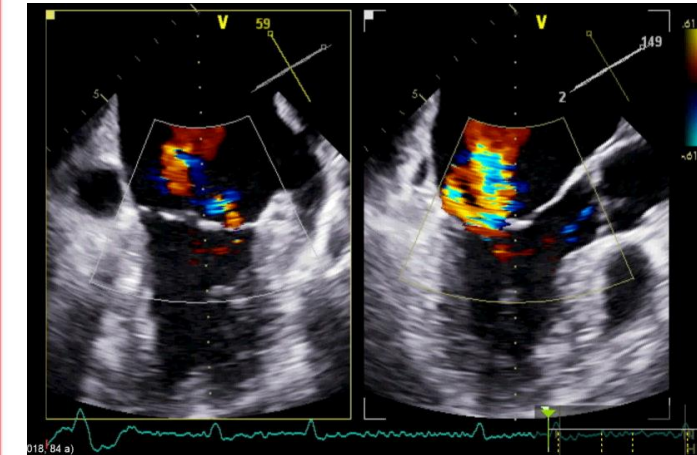
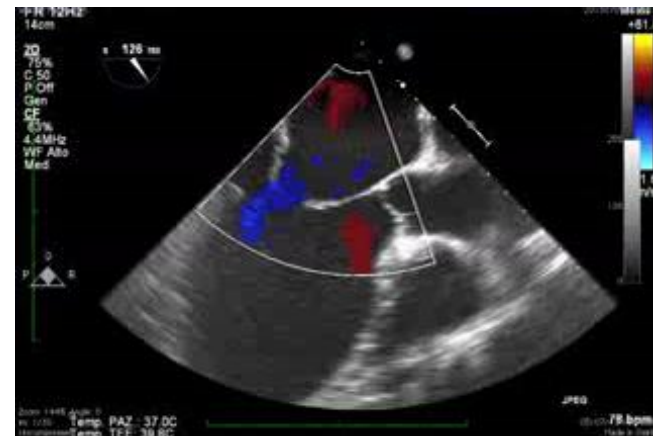
- 6%-7% in lone AF
- Up to 53% in HFpEF

- Normal systolic LV function
- Normal leaflet motion
- Central jet
- Severe LA dilation

- Address AF/HFpEF risk factors and lifestyle
- HF therapy, diuretics as indicated
- Early sinus restoration strategy
- ?Intervention, annuloplasty, MitraClip

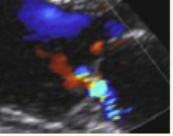

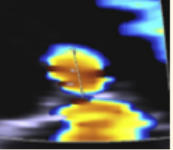
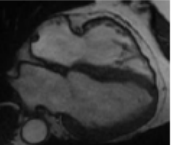
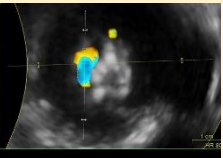
Deferm, S. et al. J Am Coll Cardiol. 2019;73(19):2465-76.

AF = atrial fibrillation; Ao = aorta; HF = heart failure; HFpEF = heart failure with preserved ejection fraction; LA = left atrium; LV = left ventricle; MR = mitral

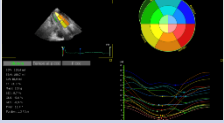
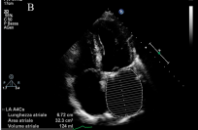
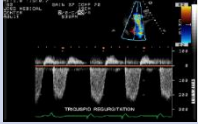

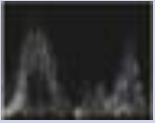


Quantification of MR Severity and Hemodynamic Severity

Quantitative Parameters of Severity

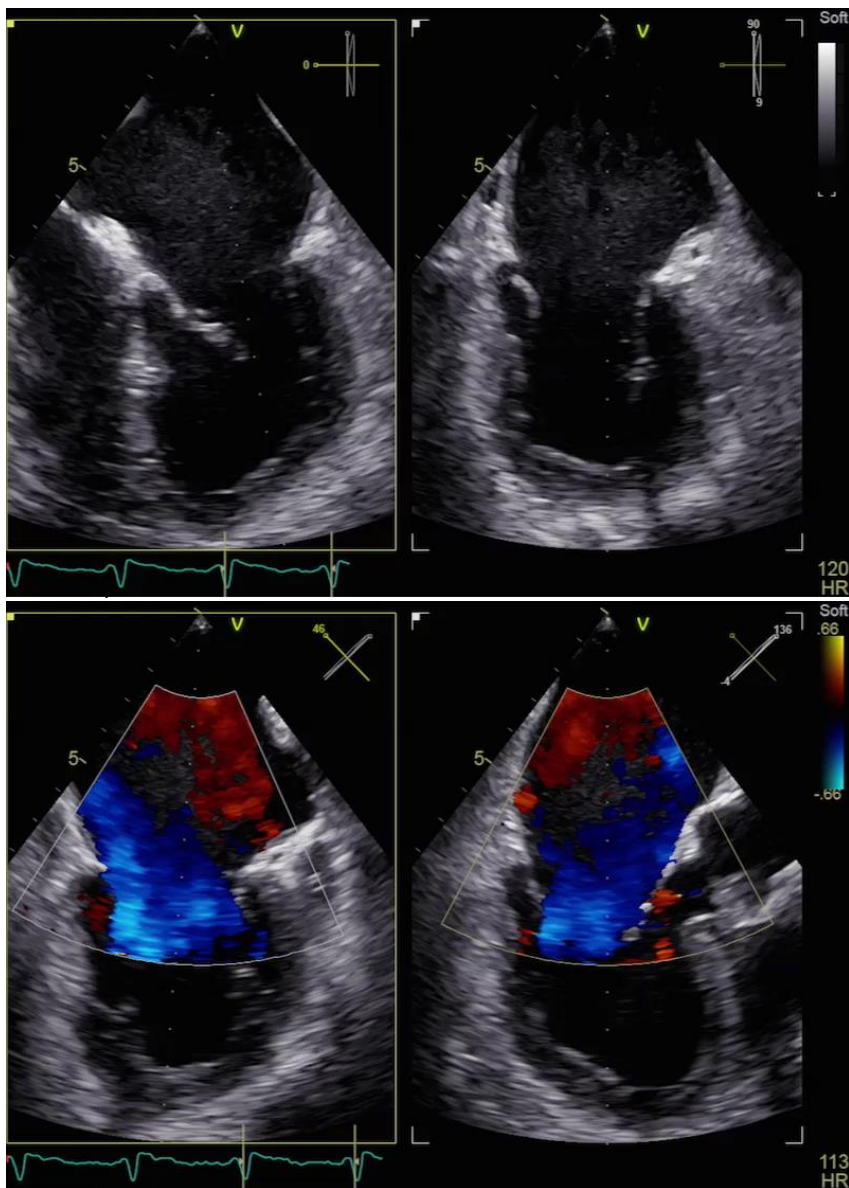
Parameter	Severe MR	Disadvantages
Vena contracta 	≥ 0.7 cm	Not valid in multiple jets; overestimates MR if not holosystolic
Continuity equation 	RVol ≥ 60 ml/beat RF $\geq 50\%$ EROA ≥ 0.4 cm ²	Measurement of flow at MV annulus prone to error especially if calcified; not valid with concomitant AR
PISA 	RVol ≥ 60 ml/beat RF $\geq 50\%$ EROA ≥ 0.4 cm ²	Not valid in multiple jets; less accurate in eccentric jets or crescent-shaped orifices
Cardiac MRI 	RVol ≥ 60 ml/beat RF $\geq 50\%$	Severity thresholds not well established; less accurate with atrial fibrillation
3D VCA 	≥ 0.4 cm ²	Good acoustic window

Parameters of Hemodynamic Burden

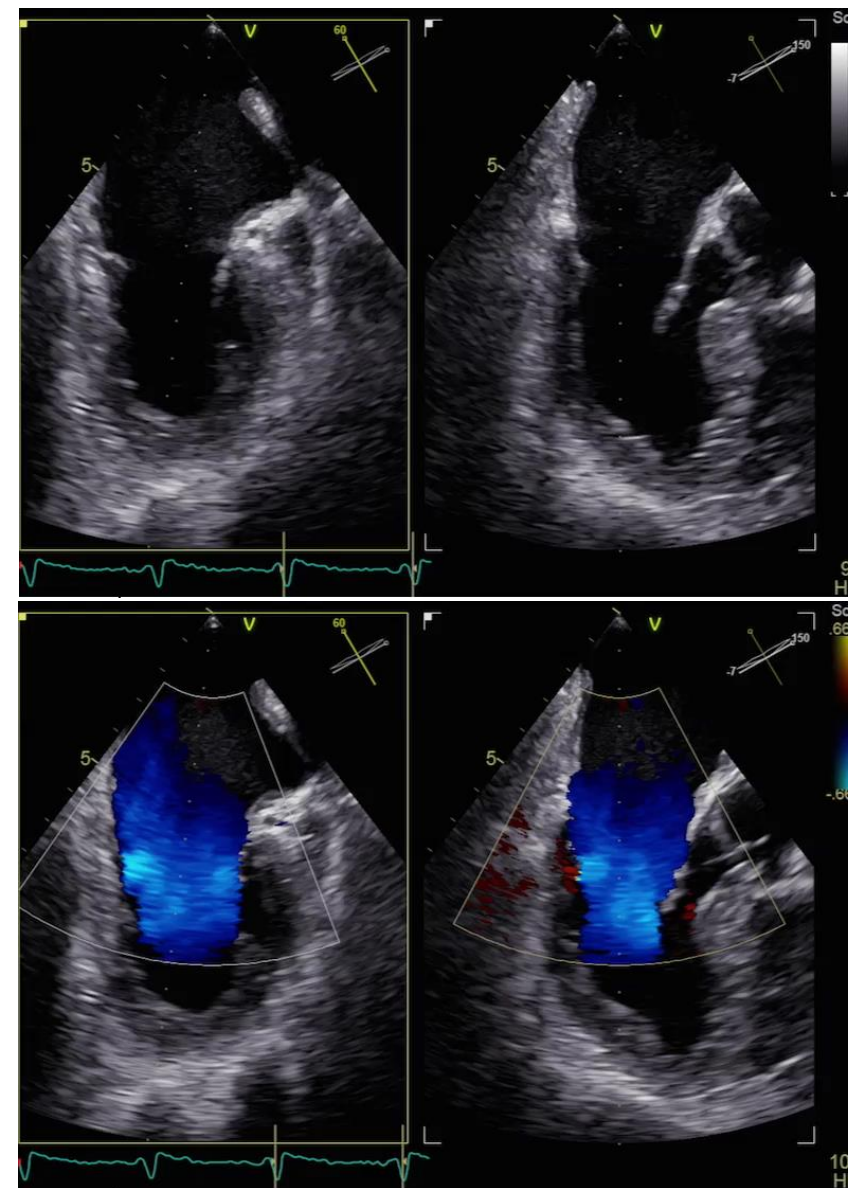
Parameters	Significant Hemodynamic Burden
LV size 	↑
LA size 	↑
Pulmonary pressure 	SPAP > 50 mmhg
Pulmonary vein signal 	Systolic flow reversal
Peak E-wave 	Peak E-wave ≥ 1.2 m/sec

Dynamic Nature of Functional MR

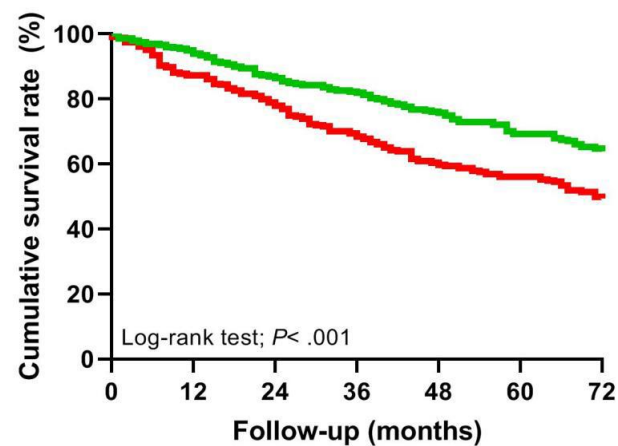
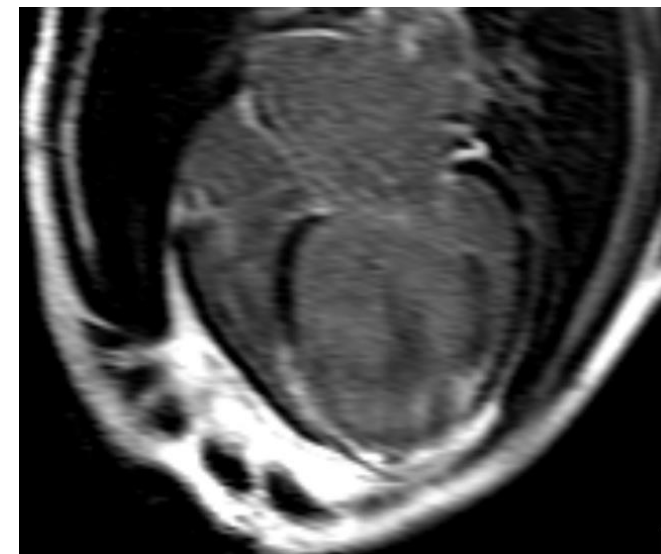
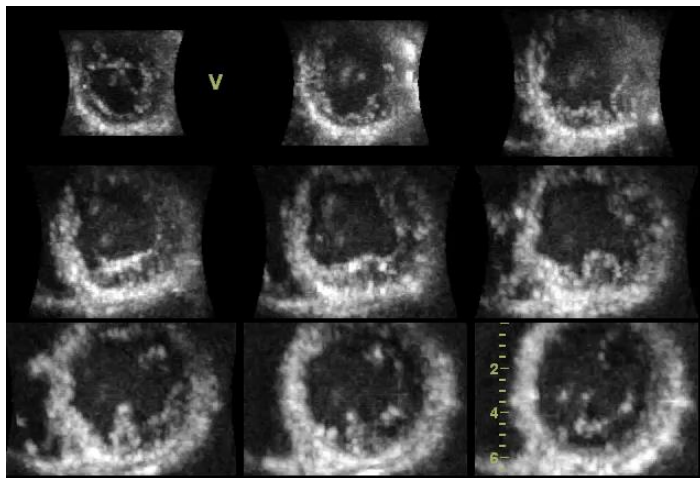
Immediately after Intubation



3 minutes Later

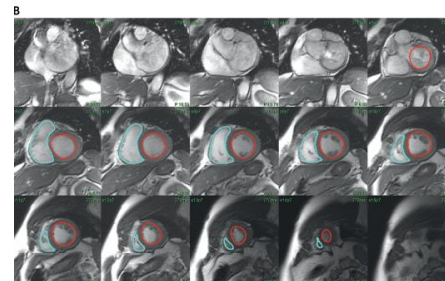
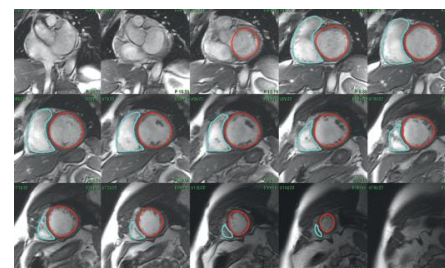
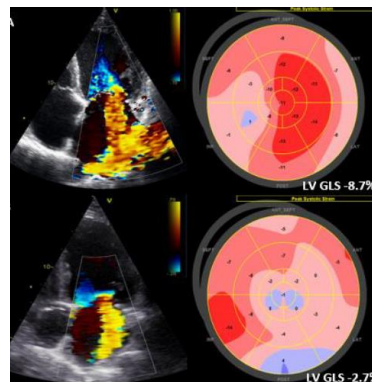


LV remodeling and function

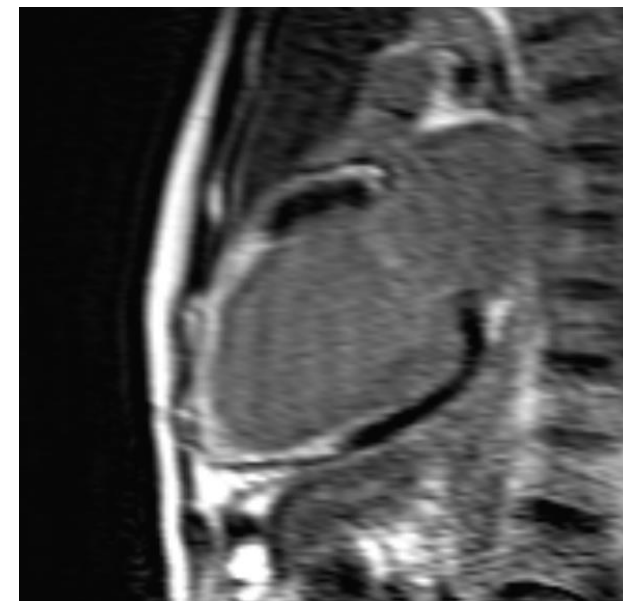


No. at risk	0	12	24	36	48	60	72
LV GLS $\leq -7.0\%$	349	323	275	234	190	157	91
LV GLS $> -7.0\%$	301	261	233	199	164	143	83

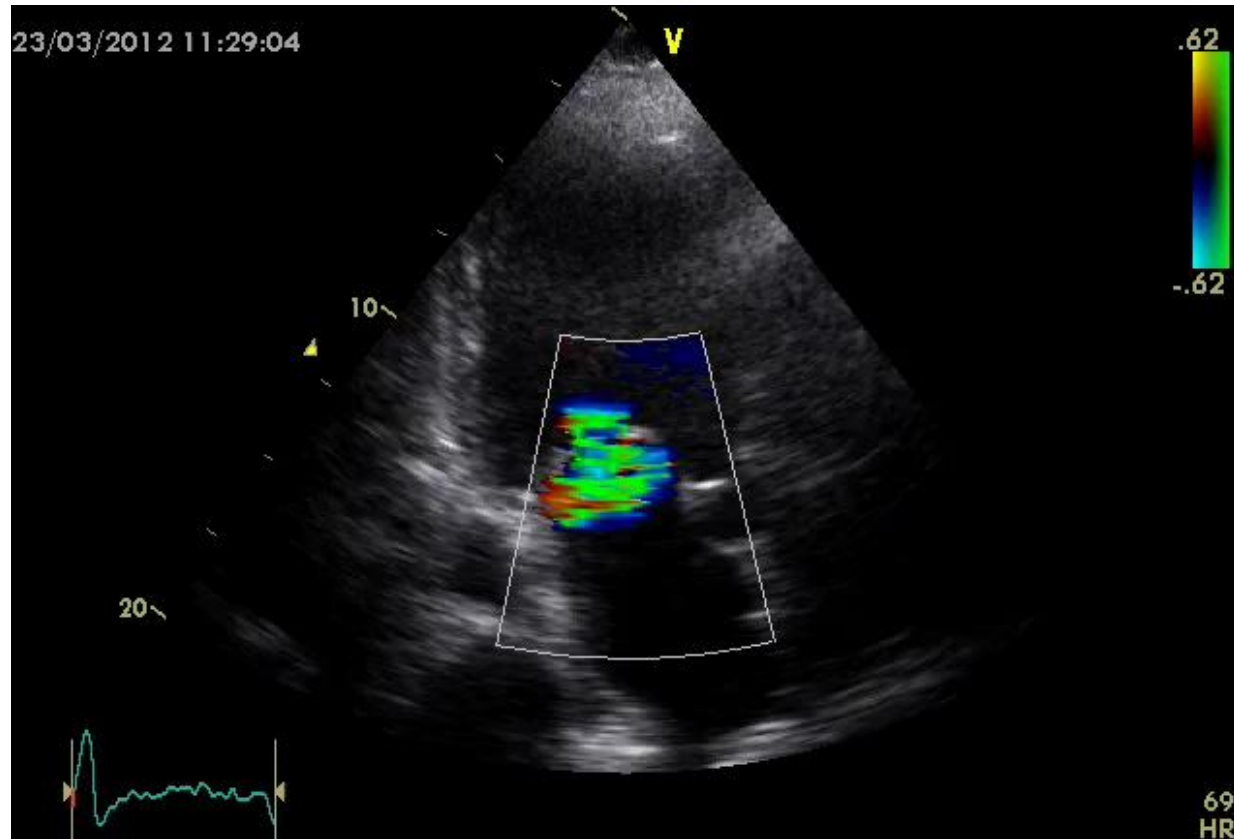
— LV GLS $\leq -7.0\%$
— LV GLS $> -7.0\%$



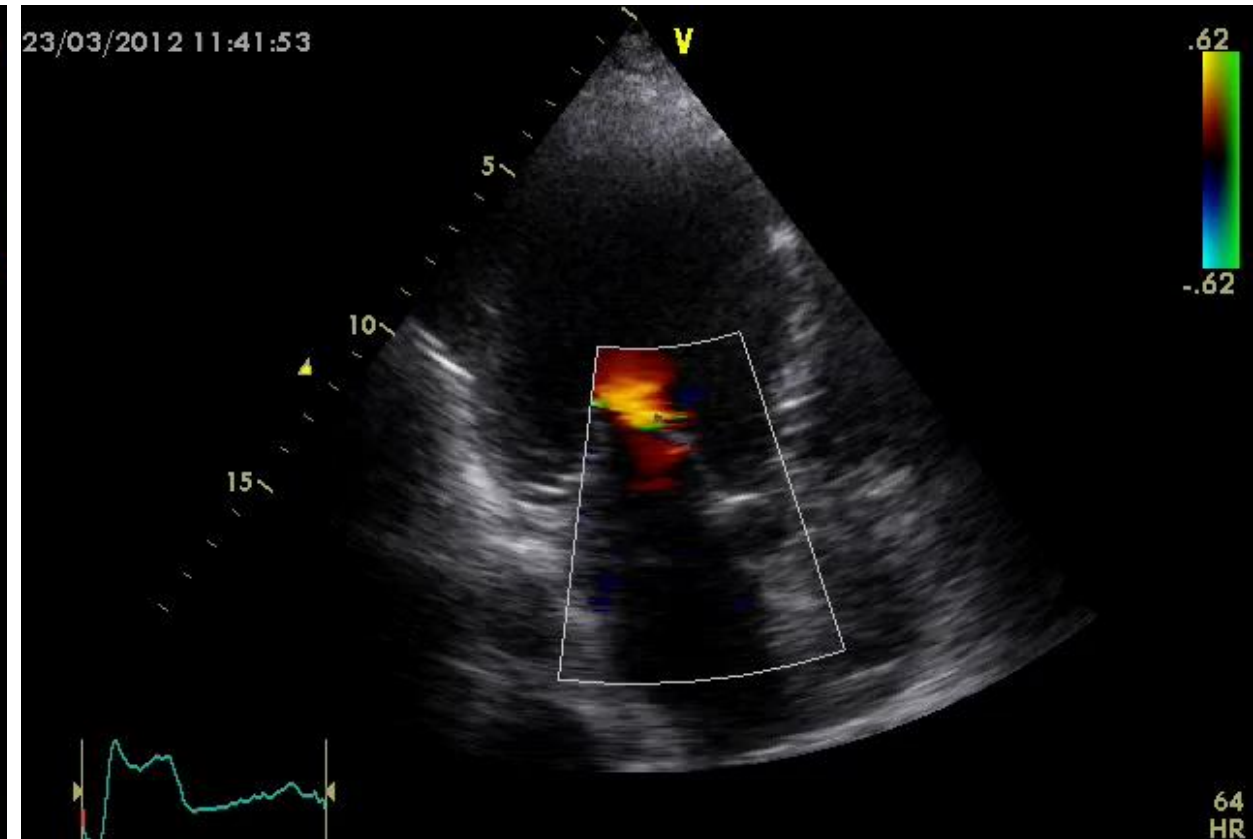
diastolic (A) and end-systolic (B) segmentation showing the left ventricular traces in red and the right ventricular traces in blue. The contrast between the blood



The role of Mechanical Dyssynchrony



CRT off



CRT on

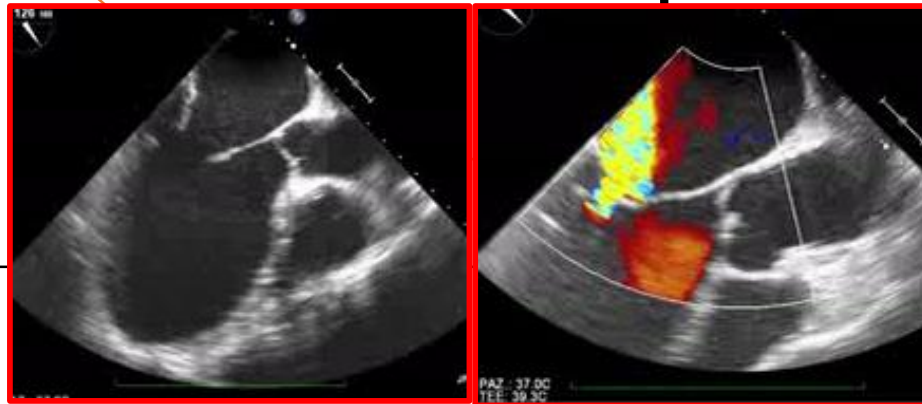
Functional Anatomy: Echocardiographic Patterns



A
R
D
I
L
L
A
T
I
O
N

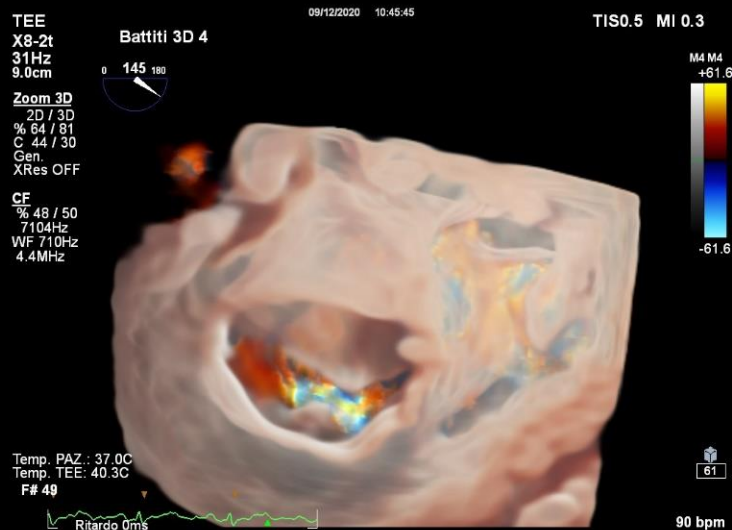
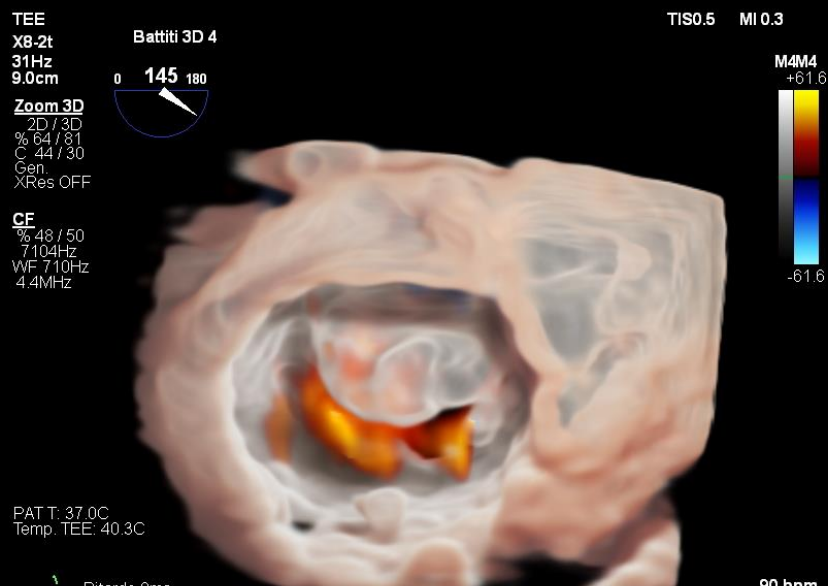


T
E
T
H
E
R
I
N
G



Imaging Assessment: Functional Anatomy of the MV

Target Lesion: Site of the origin of the jet, number of the jets, 3DVCA

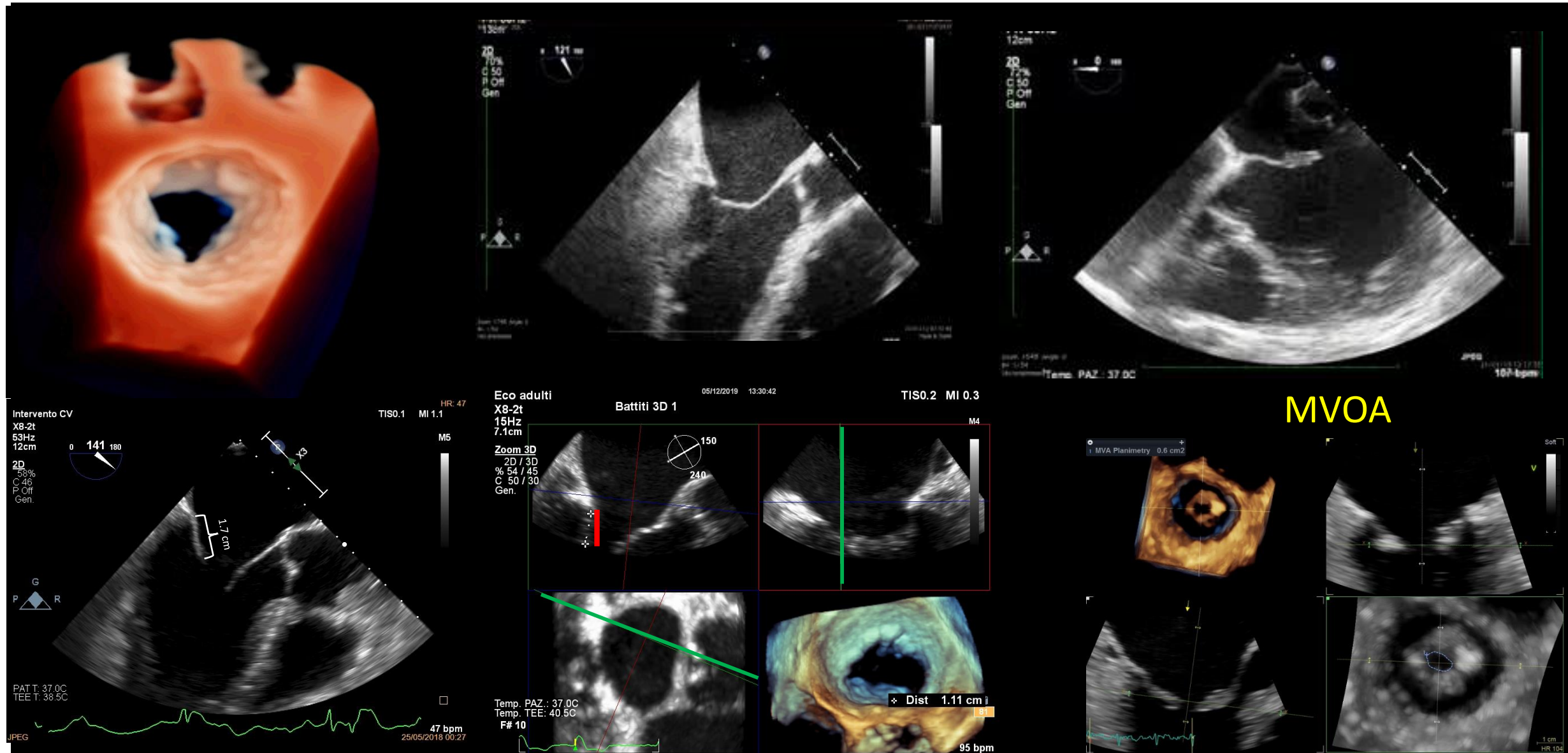


Coaptation Gap



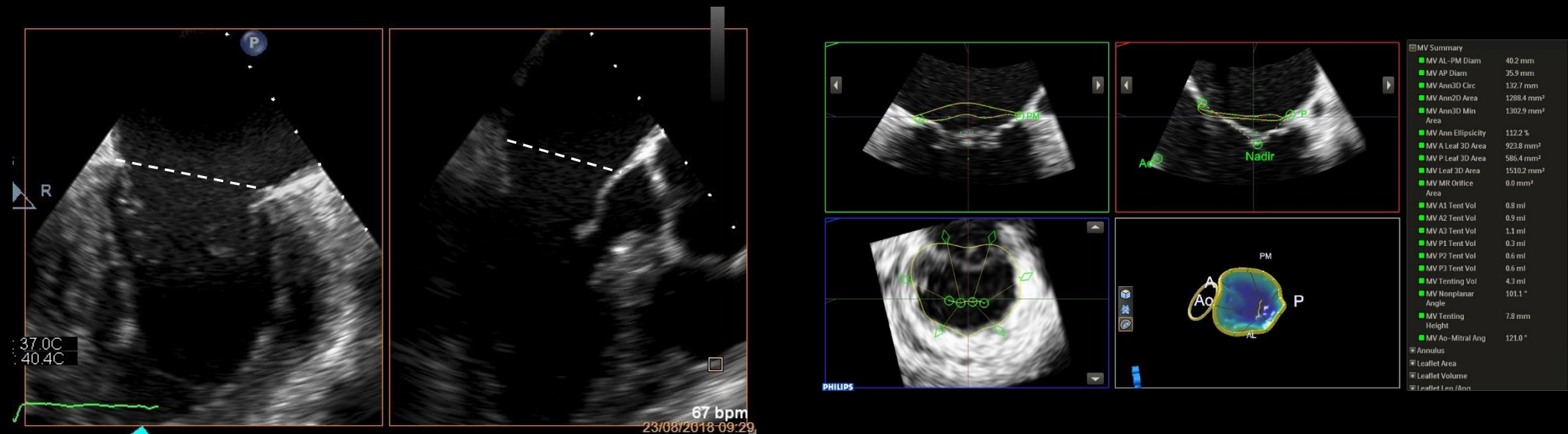
Imaging Assessment: Functional Anatomy of the MV

Target Lesion: leaflet tissue quality and MVOA

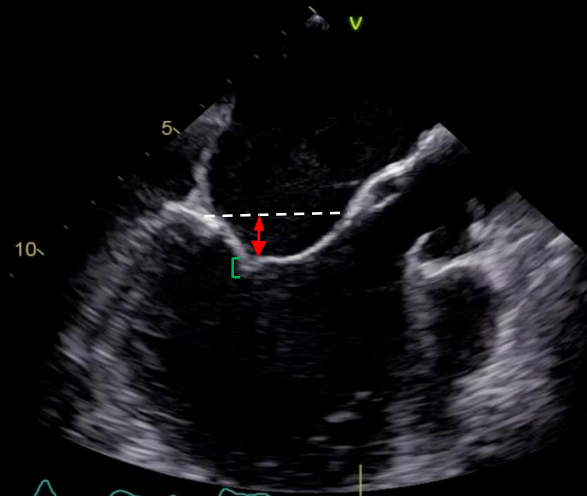


Imaging Assessment: Functional Anatomy of the MV

Annulus and MV remodeling

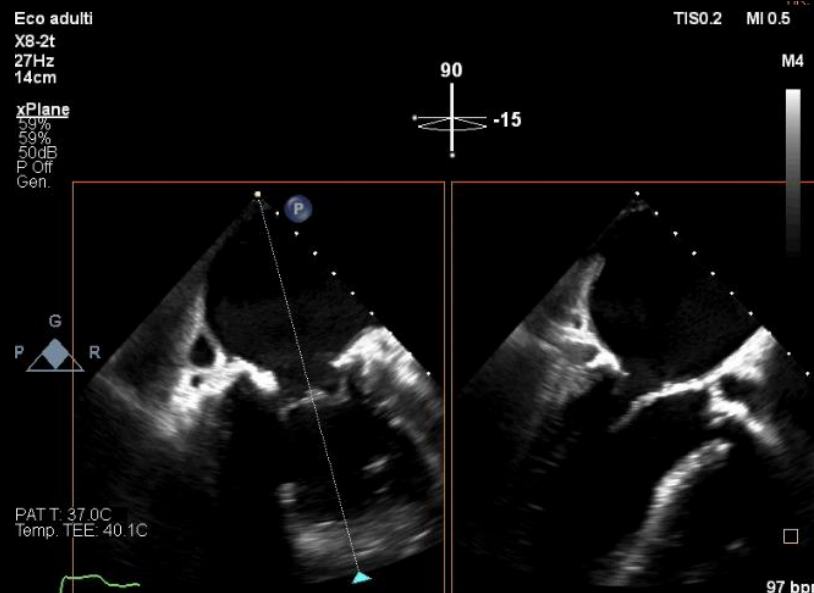


MV Remodeling



Imaging Assessment: Functional Anatomy of the MV

Calcification



Intervento CV
X8-2t
16Hz
8.4cm

Battiti 3D 1

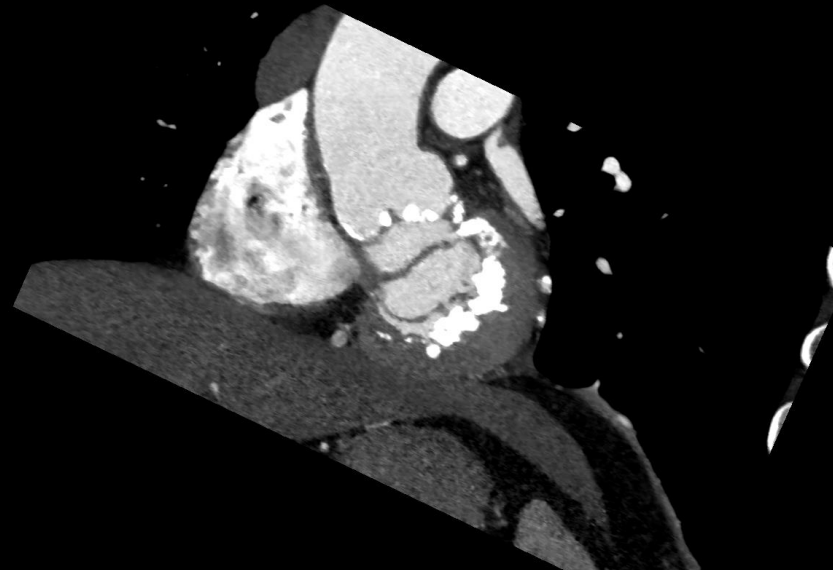
Zoom 3D
2D / 3D
% 59 / 44
C 46 / 30
Gen.
XRes ON

0 80 180

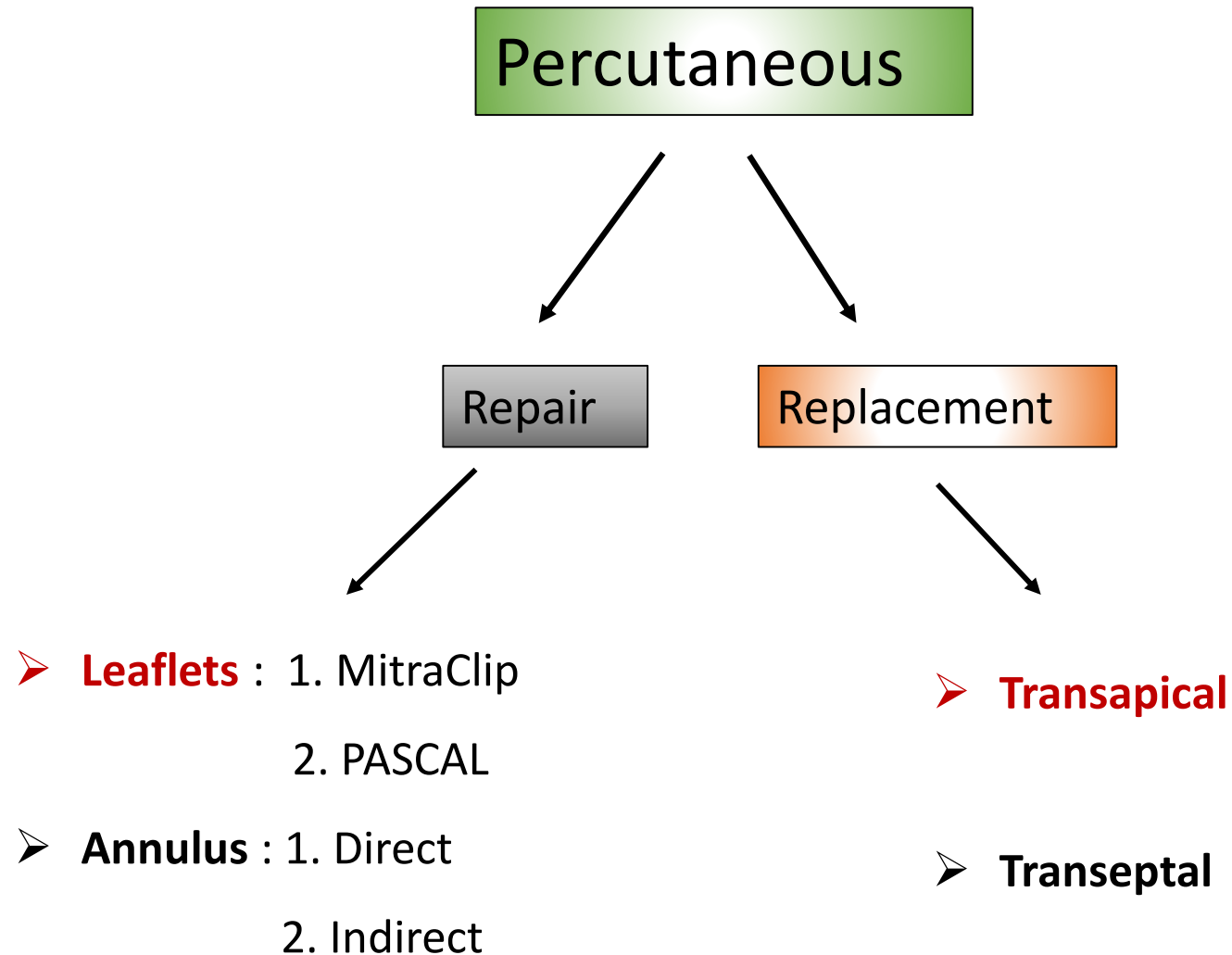


PAT T: 37.0C
Temp. TEE: 39.7C

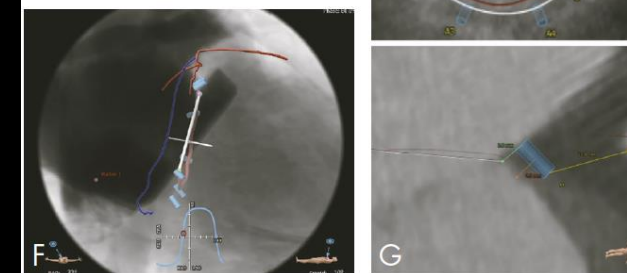
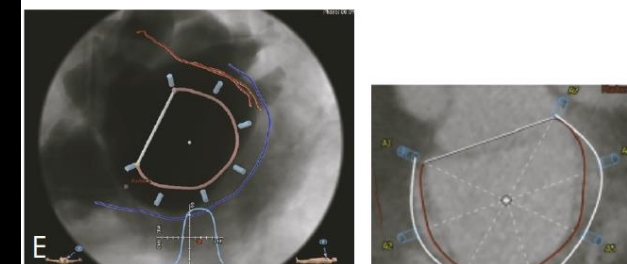
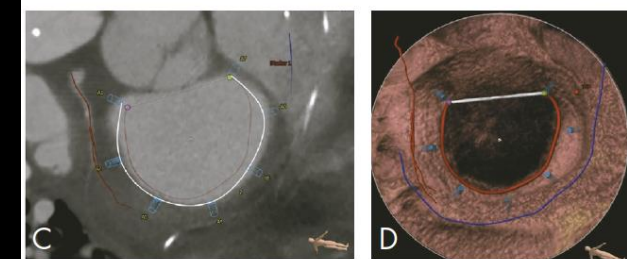
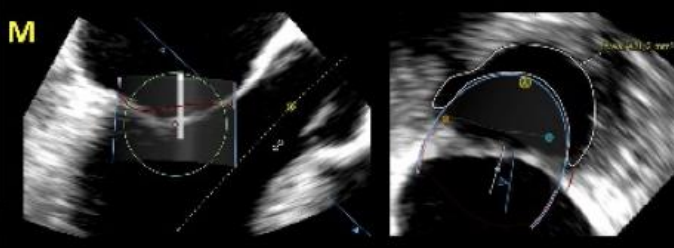
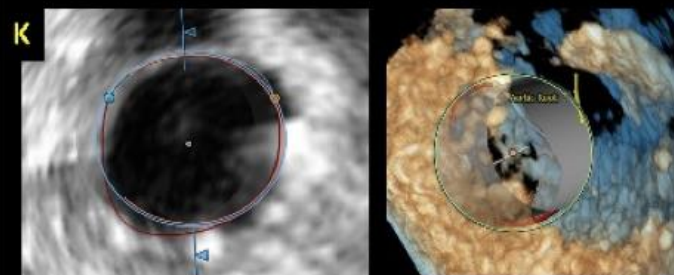
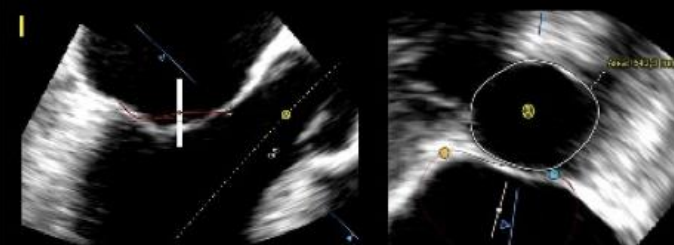
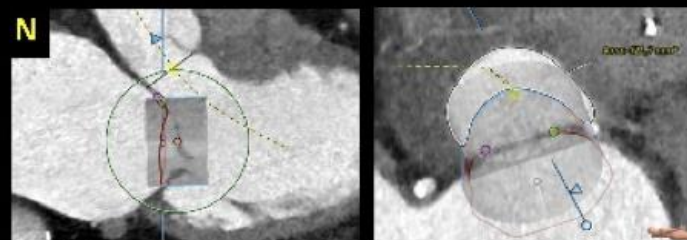
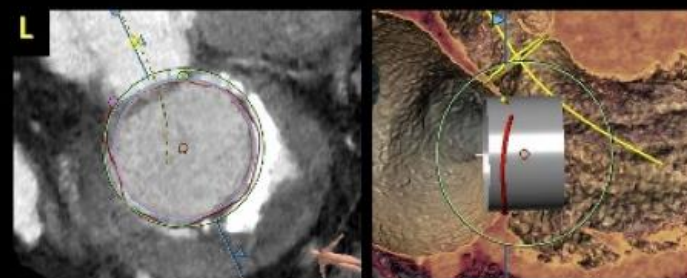
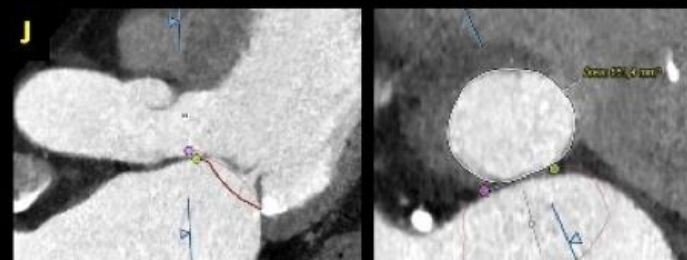
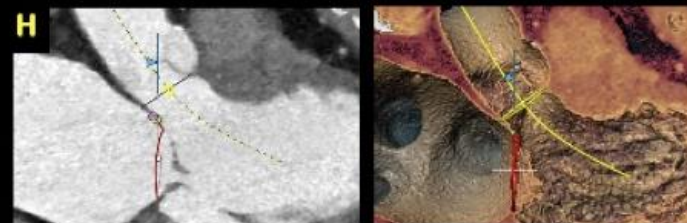
103 bpm



Mitral Valve Procedures: Which Options



Procedural Planning



Conclusions

- ✓ Multimodality imaging approach
- ✓ In-depth Quantification and Mechanisms
- ✓ Delineation of functional anatomy of the valve
- ✓ Tailored Therapeutic approach