APHP
CHU Bichat - Claude Bernard

# What echo measurements are key prior to MitraClip ?

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# Conflict of interest

- No disclosure

# Case

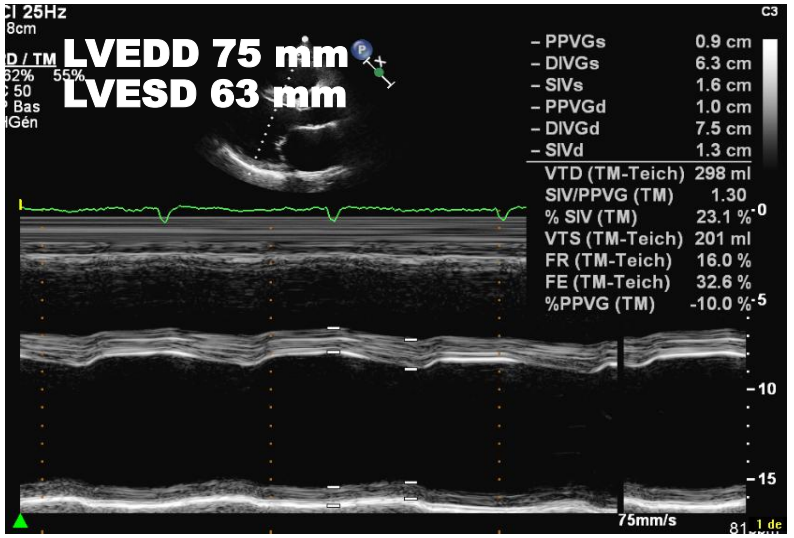
- **69 y.o man with  severe ischemic cardiomyopathy**

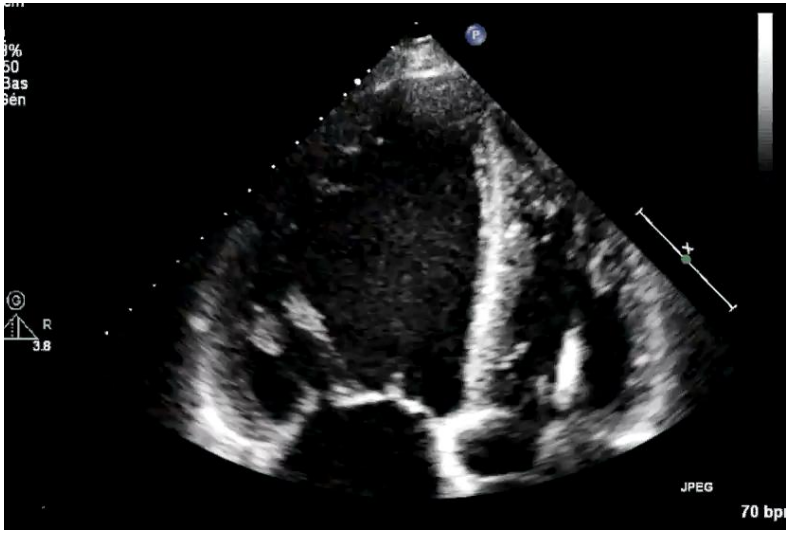
- **2007 : severe CHF**
  - **History of previous inferior MI**
  - **RCA desobtruction  + LAD stenting**
  - **LV dysfunction  EF 0.30   LV dyssynchrony**
  - **ICD + CRT implantation**
  - **NYHA II under medical Rx until 2011**

- **2011 : new episode of CHF**
  - **2/6 holosystolic murmur. S3**
  - **Clinical signs of left and right CHF**

# TTE


JPEG


LVEDD 75 mm
LVESD 63 mm
– PPVGs 0.9 cm
– DIVGs 6.3 cm
– SIVs 1.6 cm
– PPVGd 1.0 cm
– DIVGd 7.5 cm
– SIVd 1.3 cm
VTD (TM-Teich) 298 ml
SIV/PPVG (TM) 1.30
% SIV (TM) 23.1 %
VTS (TM-Teich) 201 ml
FR (TM-Teich) 16.0 %
FE (TM-Teich) 32.6 %
%PPVG (TM) -10.0 %
75mm/s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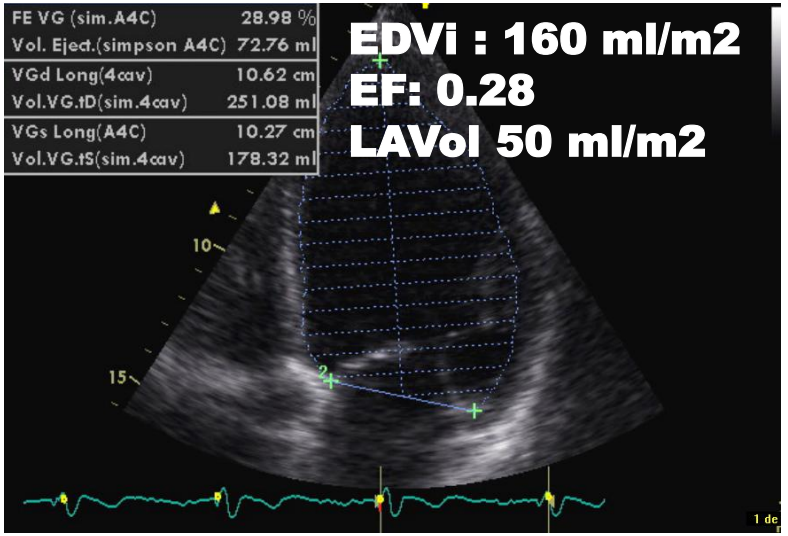
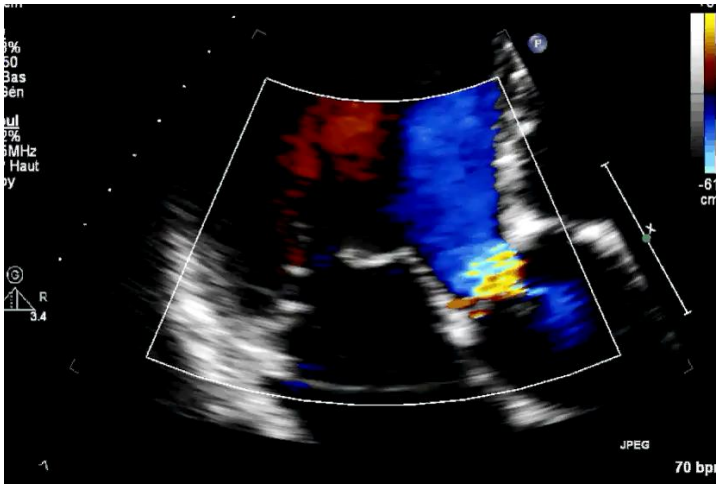
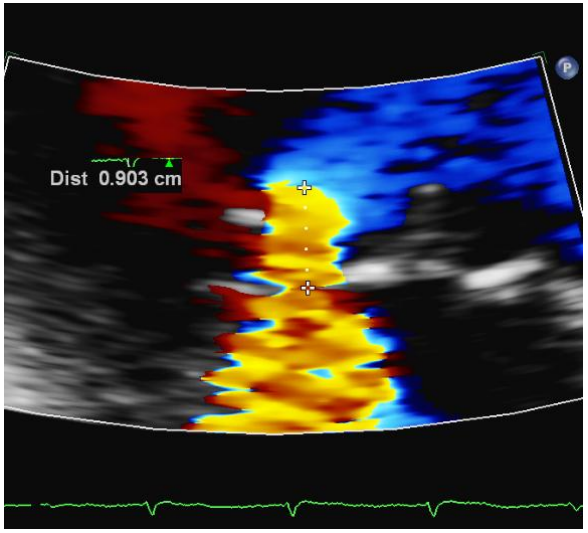
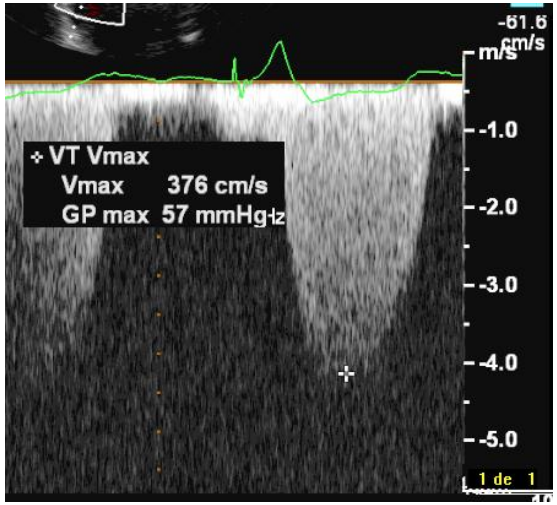

FE VG (sim.A4C) 28.98 %
Vol. Eject.(simpson A4C) 72.76 ml
VGd Long(4cav) 10.62 cm
Vol.VG.tD(sim.4cav) 251.08 ml
VGs Long(A4C) 10.27 cm
Vol.VG.tS(sim.4cav) 178.32 ml
EDVi : 160 ml/m2
EF: 0.28
LAVol 50 ml/m2

# TTE

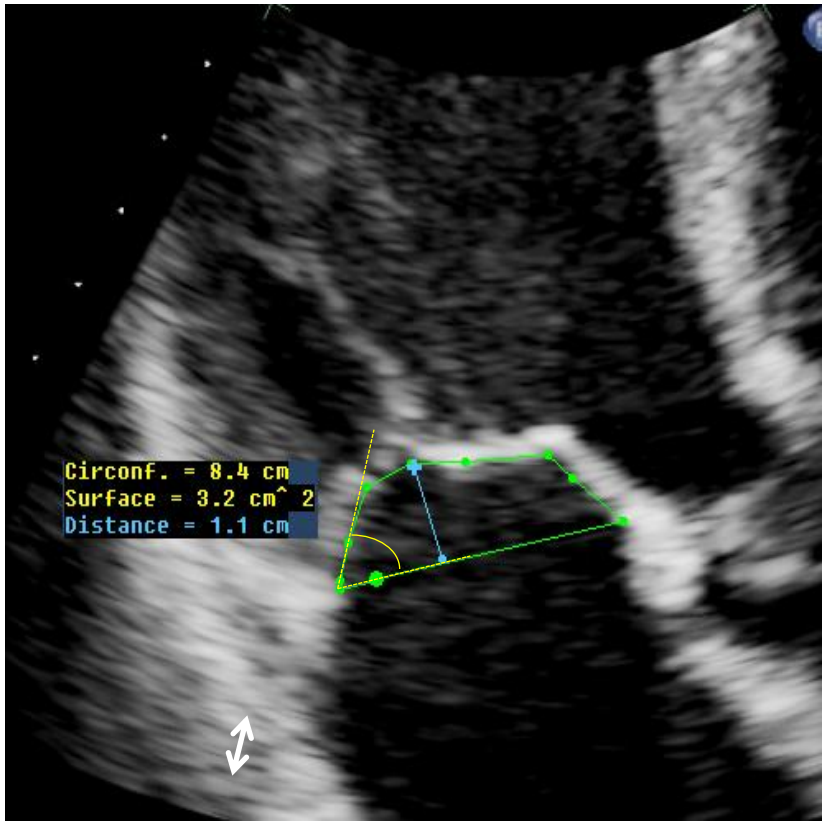




**MR quantification**

**ERO: 0.42 cm²**
**R Vol: 55 ml/bt**

**Estimated SPAP 65 mmHg**

# TTE



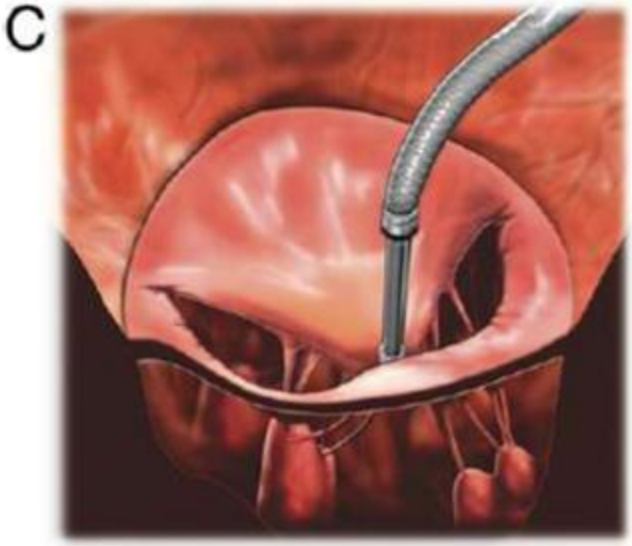

**Annulus diameter 36 mm**
**Tenting depth : 11 mm**
**Tenting area: 3.2 cm²**
**Posterolateral angle: 45°**

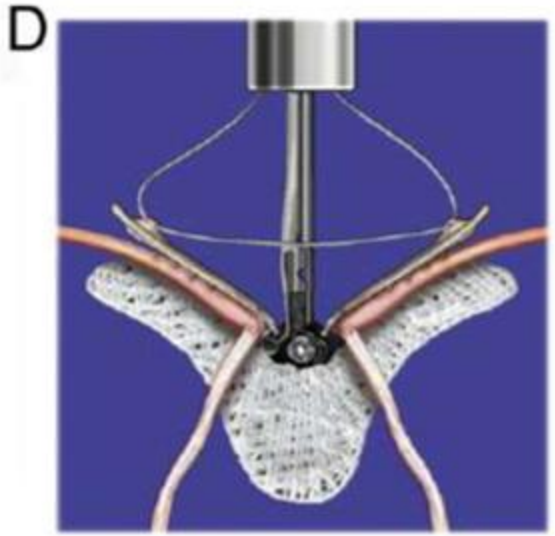
# What should we do ?

- **Coronary angio : no significant restenosis**
- **Rest TI SPECT : no viability in inferior territory**
- **Multidisciplinary team discussion**
  - **Severe symptomatic FMR**
  - **Optimal medical therapy**
  - **Already CRT**
  - **No indication for revascularization**
  - **High operative risk STS 9% Euroscore I 16%**

**Candidate for Mitraclip implantation ?**

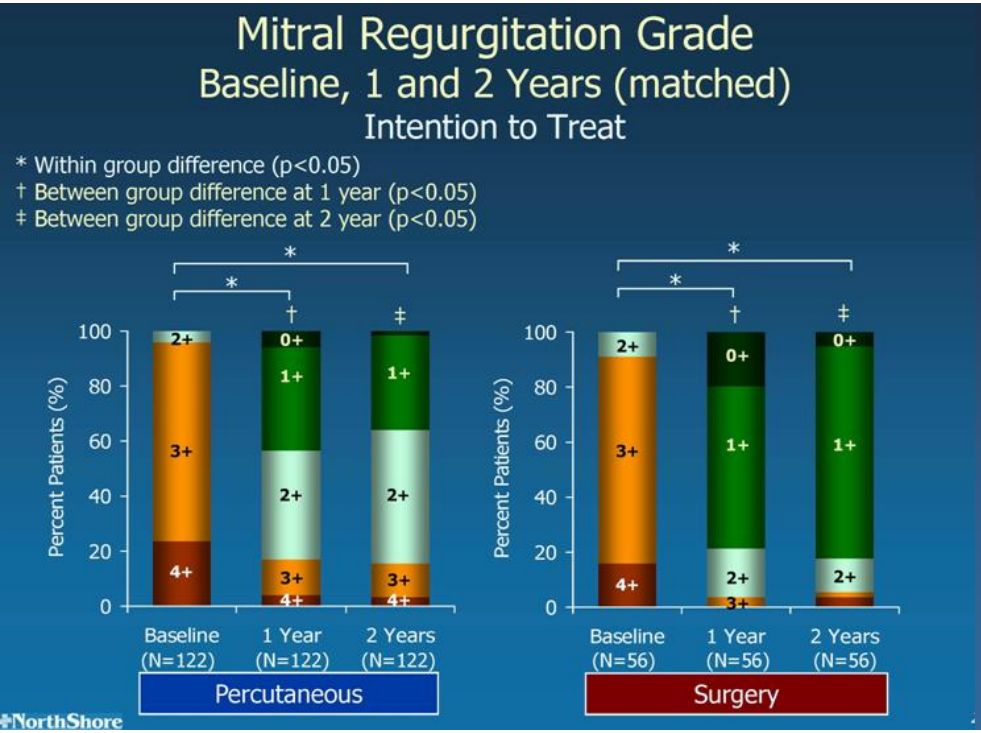
# Mitraclip therapy

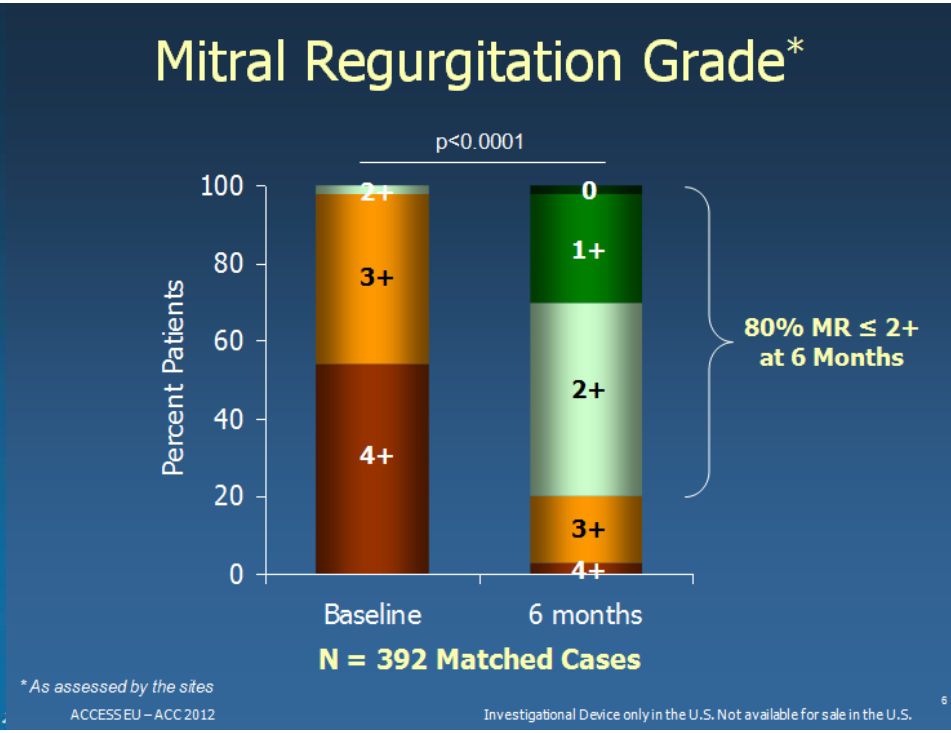



Maisano et al, J Am Coll Cardiol 2011;58: 2174–82

# Mitraclip therapy




**EVEREST II** **ACCESS EU**

**More than 6000 implantations worldwide**

# Mitraclip therapy

- **Experience with Mitraclip**
  - **Safe procedure. Low mortality**
  - **High implant rate (99.6 % ACCESS EU)**
  - **Reduction of MR but less than surgery (20 % of grade 3-4 with clip vs 3-4% with surgery at 1 year)**
  - **Similar functional improvement and LV remodelling between clip and surgery**
  - **Shift to functional MR (80 % in Europe)**

# Mitraclip therapy

***Percutaneous edge-to-edge procedure may be considered in patients with symptomatic severe primary MR or symptomatic severe secondary MR despite optimal medical therapy (including CRT if indicated)***

***who fulfill the echo criteria of eligibility***

***are judged inoperable or at high surgical risk by a 'heart team' and have a life expectancy greater than 1 year***

***(recommendation class IIb, level of evidence C)***

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

# Mitraclip therapy

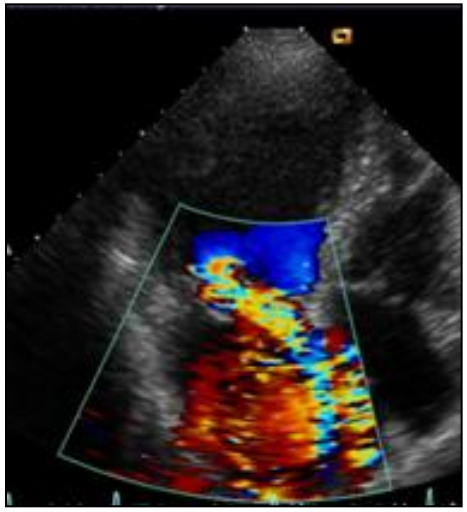
## Selection of patients

- **Patient selection is strongly influenced by clinical and anatomical factors**

- **Essential role of echocardiography**
  - **Grade 3 to 4 degenerative or functional MR**
  - **MR originating from the A2P2 area**
  - **Sufficient tissue for mechanical caption of the valve**

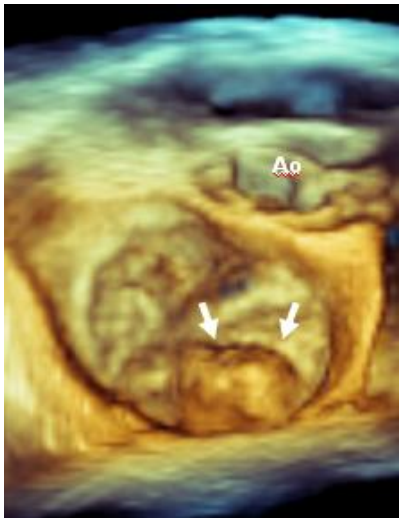
# Mitraclip therapy

## Selection of patients



TTE

TEE




3D TEE

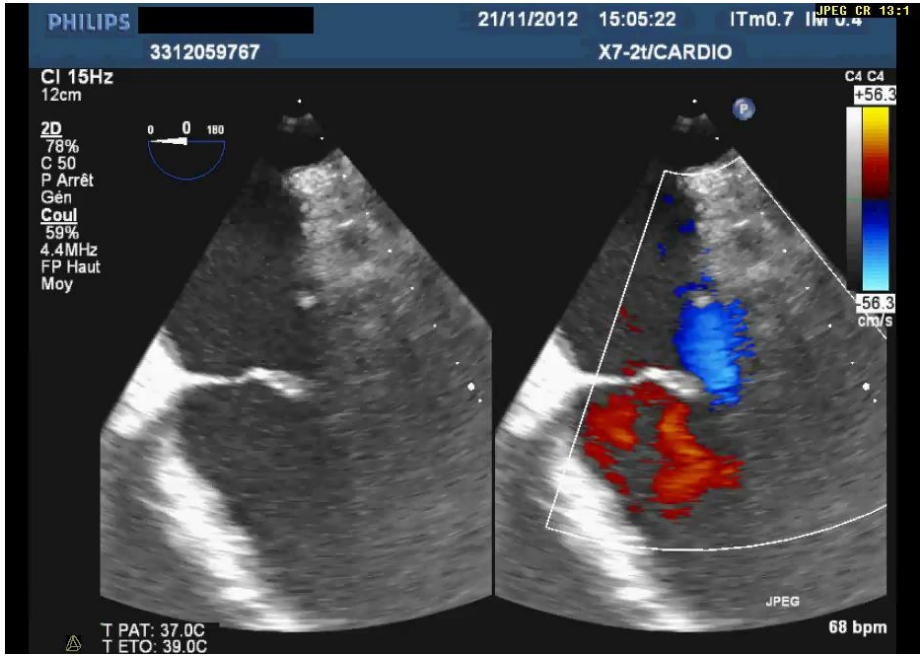
- **Multiple echo modalities**
- **Comprehensive and systematic assessment of MR**
  - **Key echocardiographic views in each echo modality**
  - **Optimal visualization of MR origin and valve pathology**

# Mitraclip therapy

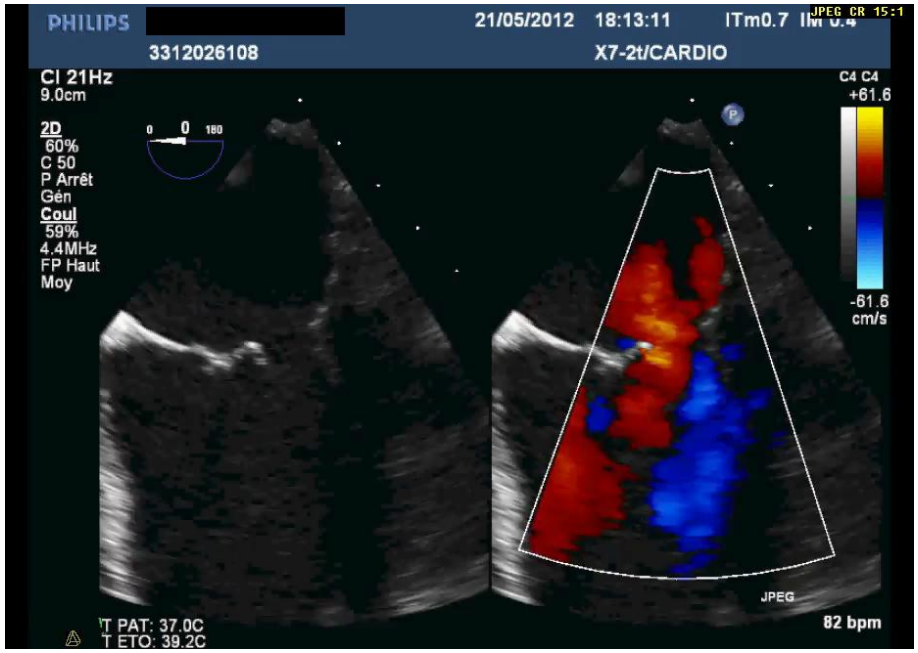
## Selection of patients

- **Type and mechanisms of MR**
- **Severity of MR**
- **Location of MR**
- **Morphology of the MV apparatus**
- **Specific measurements**
- **Additional feasibility parameters**

# Type of MR

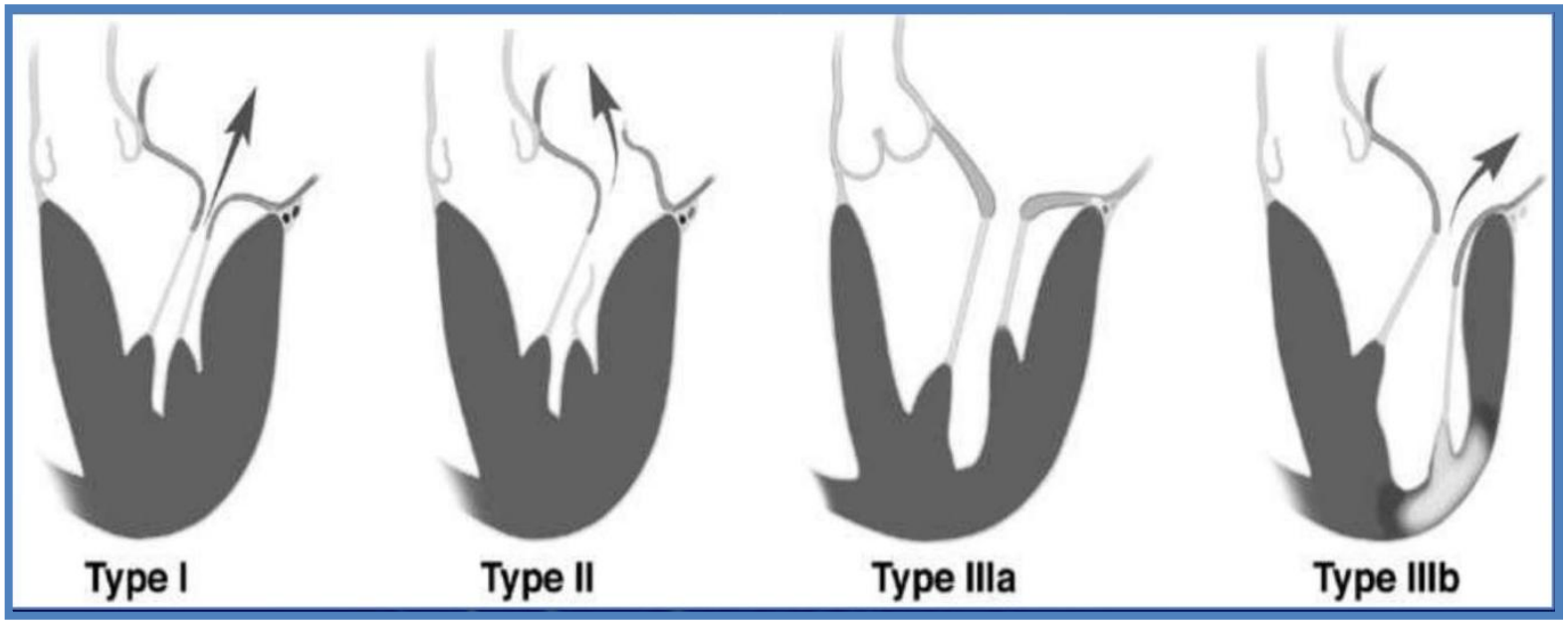



Organic or primary MR




Functional or secundary MR

# Type and mechanisms of MR




Nl Leaflet Motion | Prolapse | Restricted Motion

**Carpentier's Classification**

# Echocardiographic criteria for the definition of severe valve regurgitation: *an integrative approach*

| | Aortic regurgitation | Mitral regurgitation | | Tricuspid regurgitation |
|---|---|---|---|---|
| **Semiquantitative** | | | | |
| **Vena contracta width (mm)** | > 6 | ≥ 7 (> 8 for biplane) | | ≥ 7 |
| **Upstream vein flow** | – | Systolic pulmonary vein flow reversal | | Systolic hepatic vein flow reversal |
| **Inflow** | – | E-wave dominant ≥ 1.5 m/s | | E-wave dominant ≥ 1 m/s |
| **Other** | Pressure half-time < 200 ms | TVI mitral/TVI aortic > 1.4 | | PISA radius > 9 mm |
| **Quantitative** | | ***Primary*** | ***Secondary*** | |
| **EROA ($mm^2$)** | ≥ 30 | ≥ 40 | ≥ 20 | ≥ 40 |
| **R Vol (ml/beat)** | ≥ 60 | ≥ 60 | ≥ 30 | ≥ 45 |
| **+ enlargement of cardiac chambers/ vessels** | LV | LV, LA | | RV, RA, inferior vena cava |

Adapted from Lancellotti, EAE recommendations. *Eur J Echocardiogr.* 2010;11:223-244 and 307-332

European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).

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EUROPEAN SOCIETY OF CARDIOLOGY®

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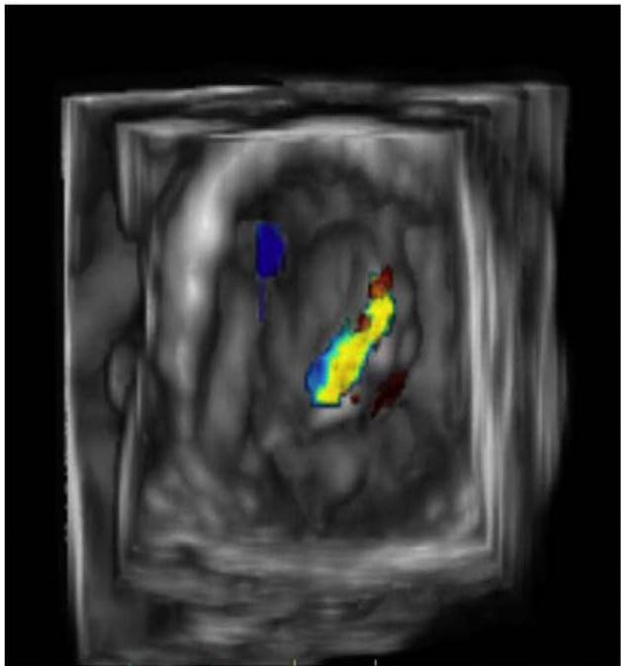
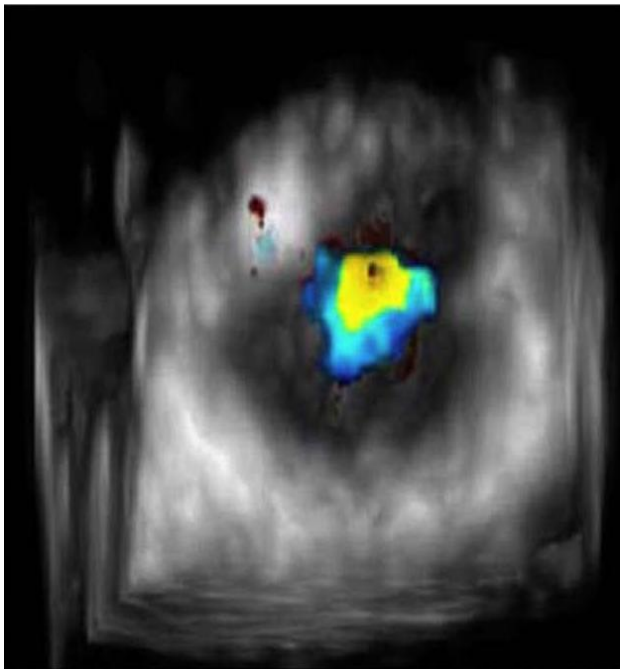
European Journal of Cardio-Thoracic Surgery 2012 -
doi:10.1093/ejcts/ezs455).

# PISA 3D geometry with 3DTTE



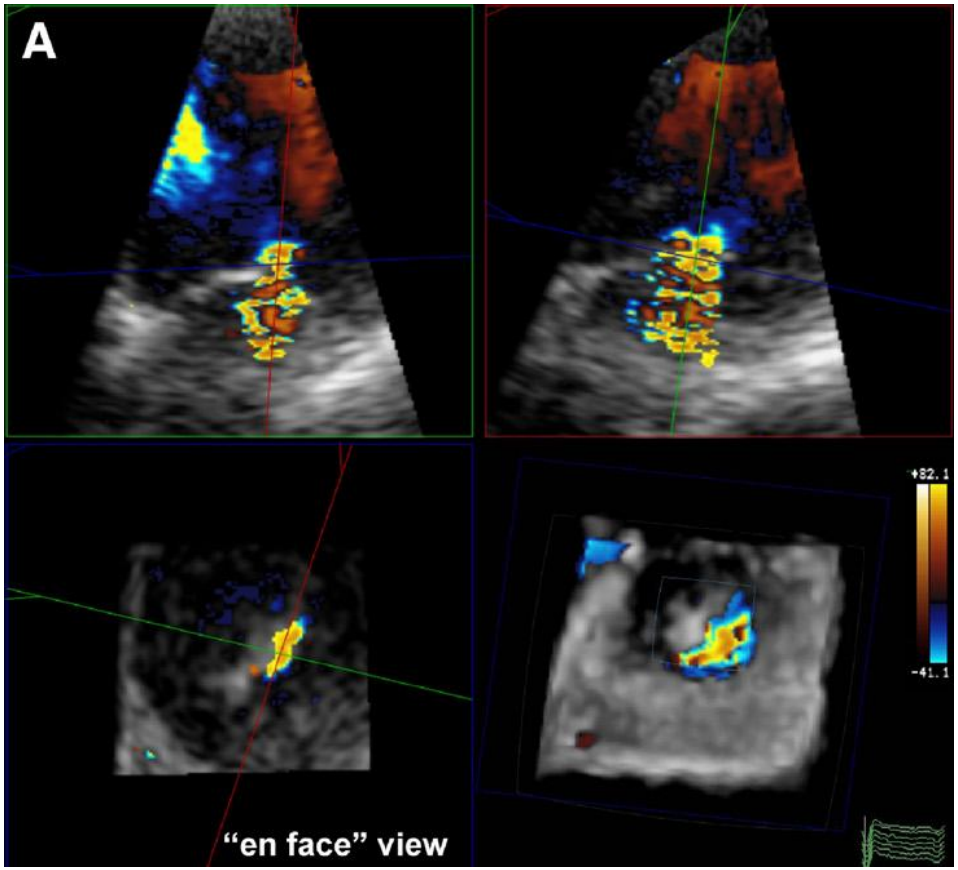
***Functional MR***

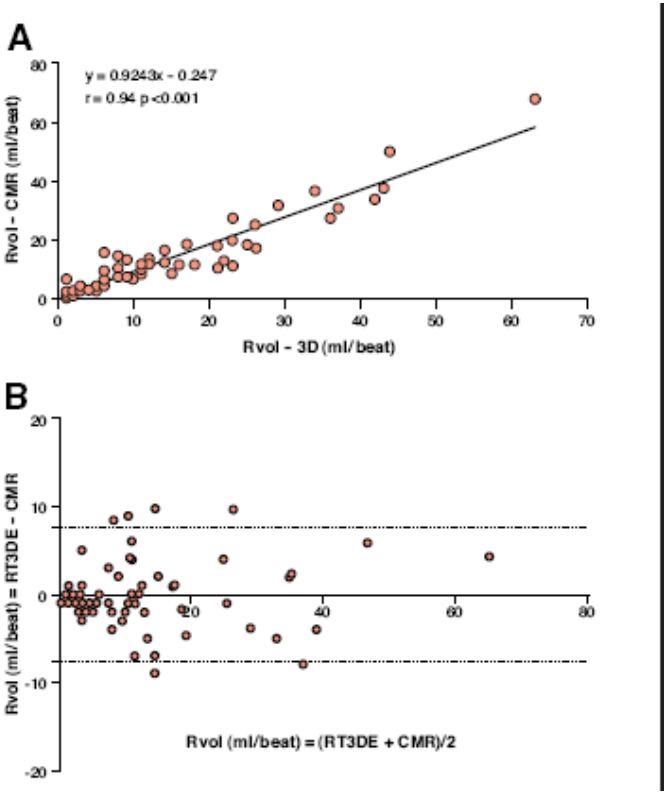


***Organic MR***

Matsumura et al, Am Heart J 2008; 155: 231-8

# Quantification of Functional MR by RT3D Echocardiography



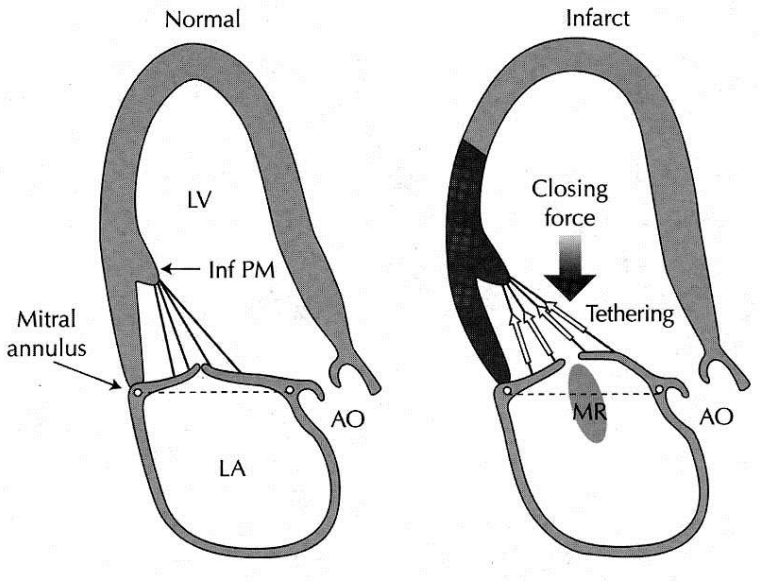




Ajmone Marsan et al J Am Coll Cardiol Img 2009;2:1245–52

# Secondary MR

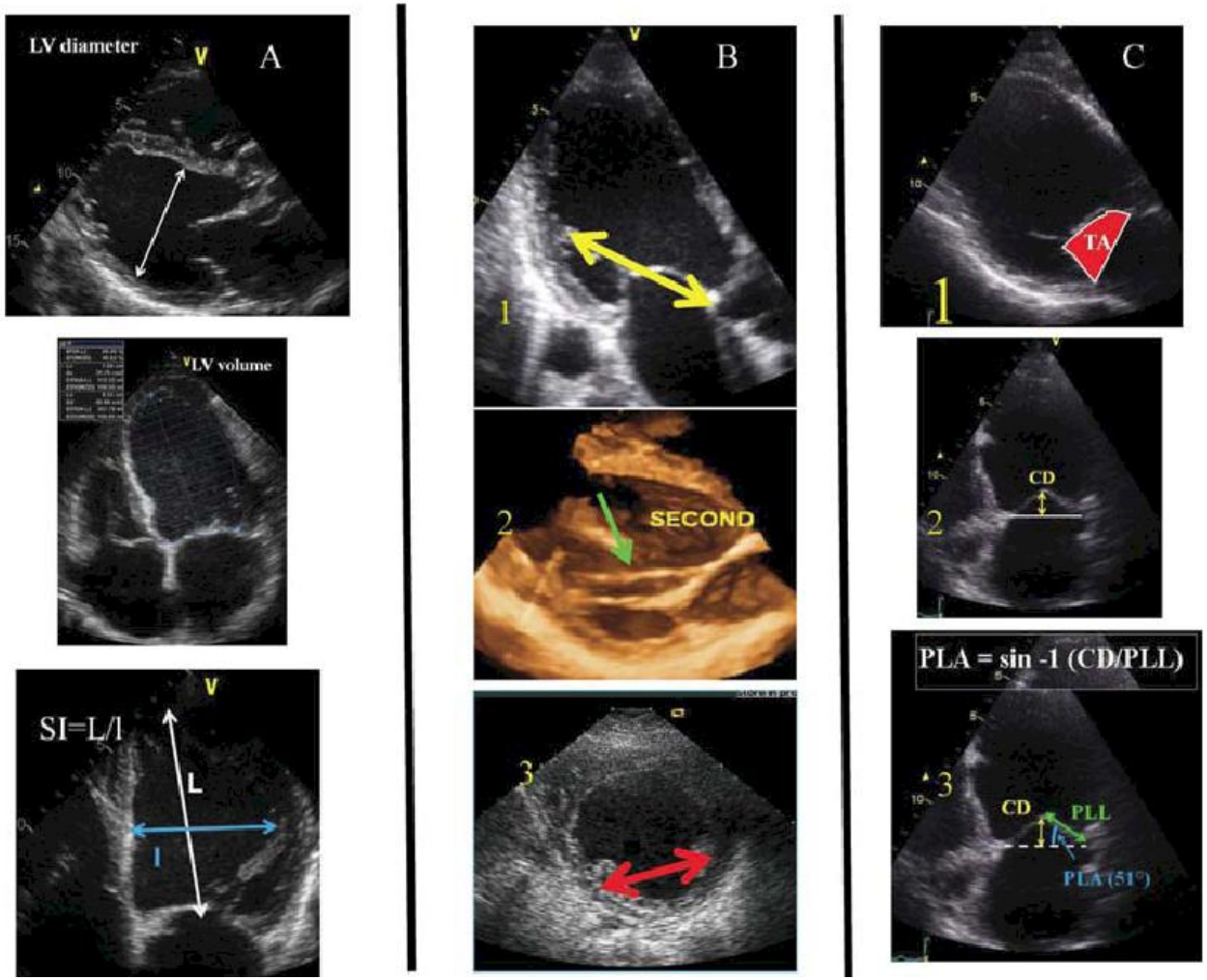
- **Ischaemic or functional MR**

- **Local remodelling ± wall motion abnormalities**
  - **Displacement of papillary muscles**
  - **Traction on mitral leaflets (tethering)**
  - **Tenting and incomplete closure**
- **Imbalance between ↑ tethering and closure forces**



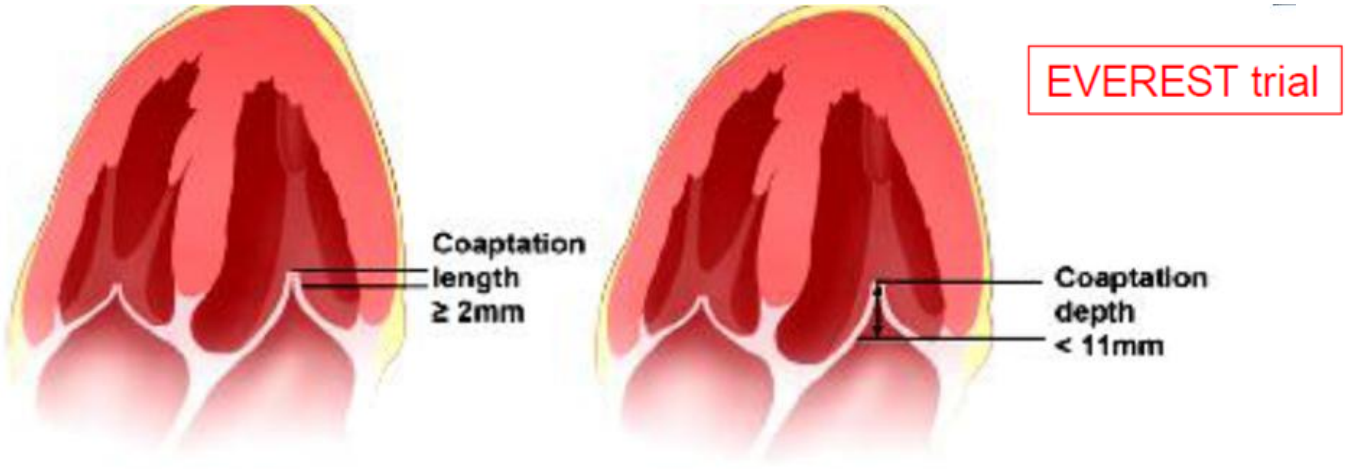

*(Levine et al. Curr Cardiol Rep 2002;4:125-9)*

# Secondary MR



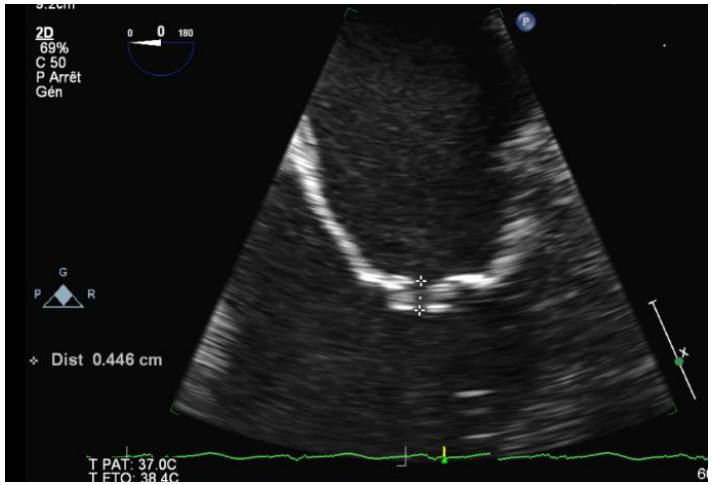

Lancellotti P et al. Eur J Echocardiogr 2010;11:307-332

# Secondary MR

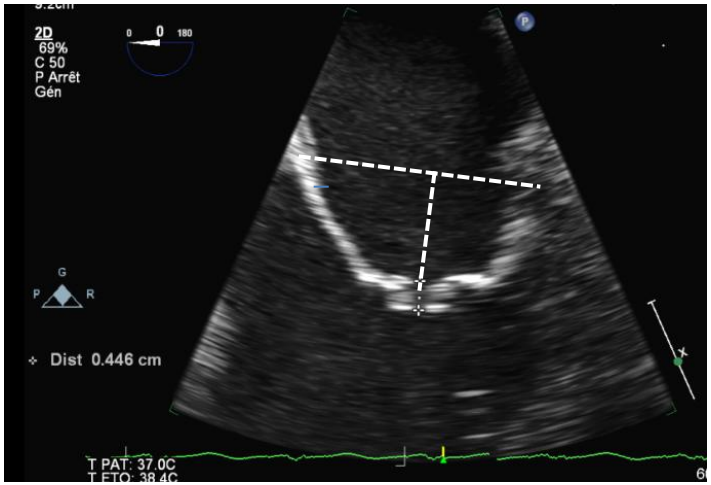



FUNCTIONAL MITRAL REGURGITATION

Feldman T et al JACC 2009; 54 :686-94



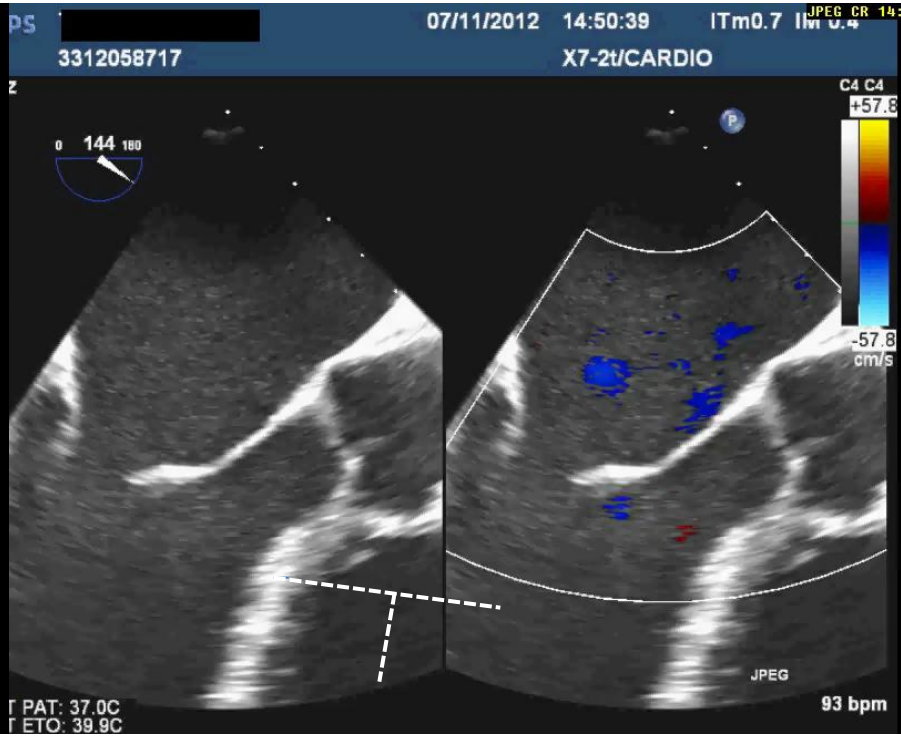

**Coaptation length ≥ 2 mm**




**Coaptation depth < 11 mm**

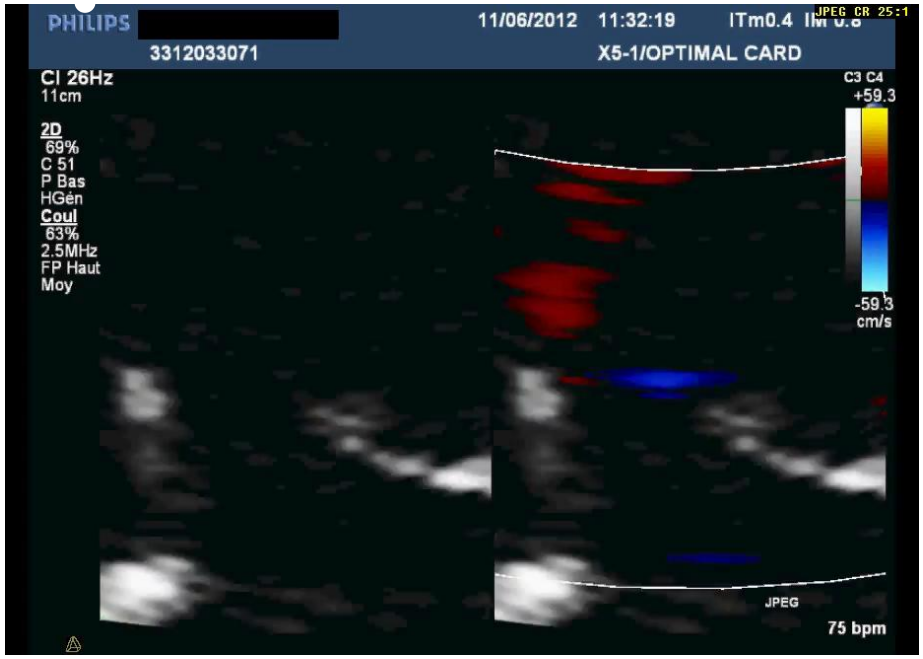
# Secondary MR

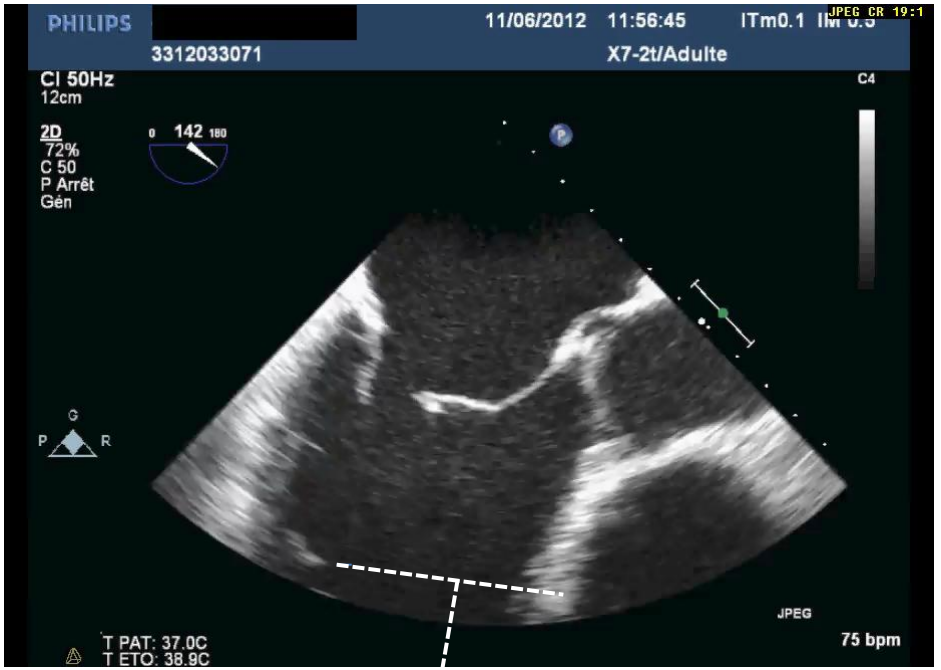
## Good candidate

# Secondary MR

## Less favorable candidate

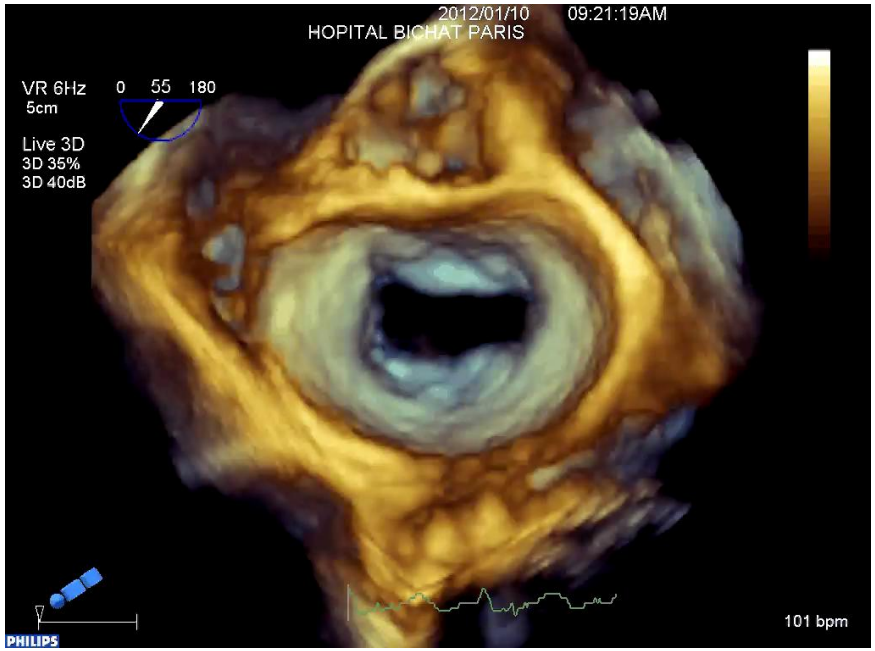


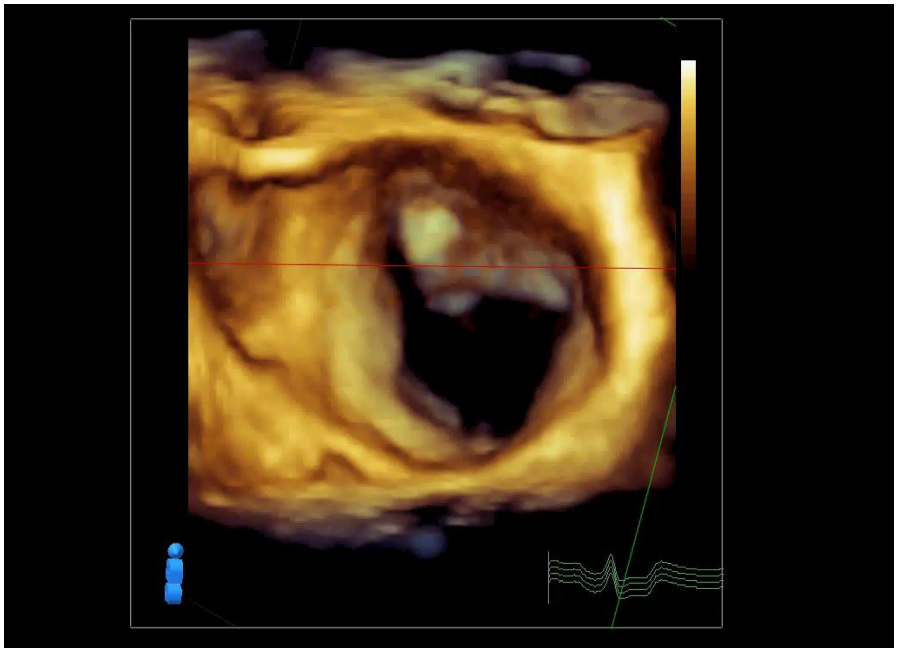




**Lack of coaptation of the leaflets**

# Secondary MR
# Role of 3D TEE

## Type IIIb MR



Symmetric closure

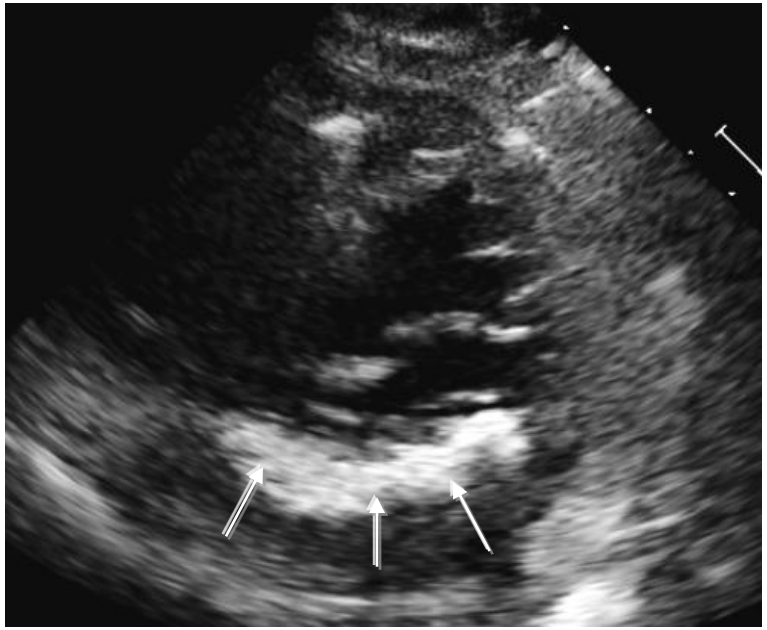
Asymmetric closure

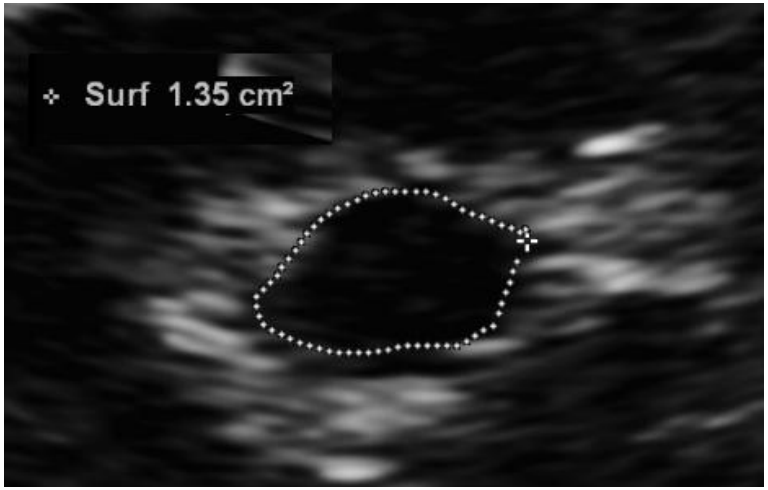
# Secondary MR
# Role of 3D TEE

- **Others parameters to assess**
  - **Morphology of the valve**
  - **LV dimensions and function**
  - **Dyssynchrony**
  - **other exclusion criteria**

# Morphology of the valve

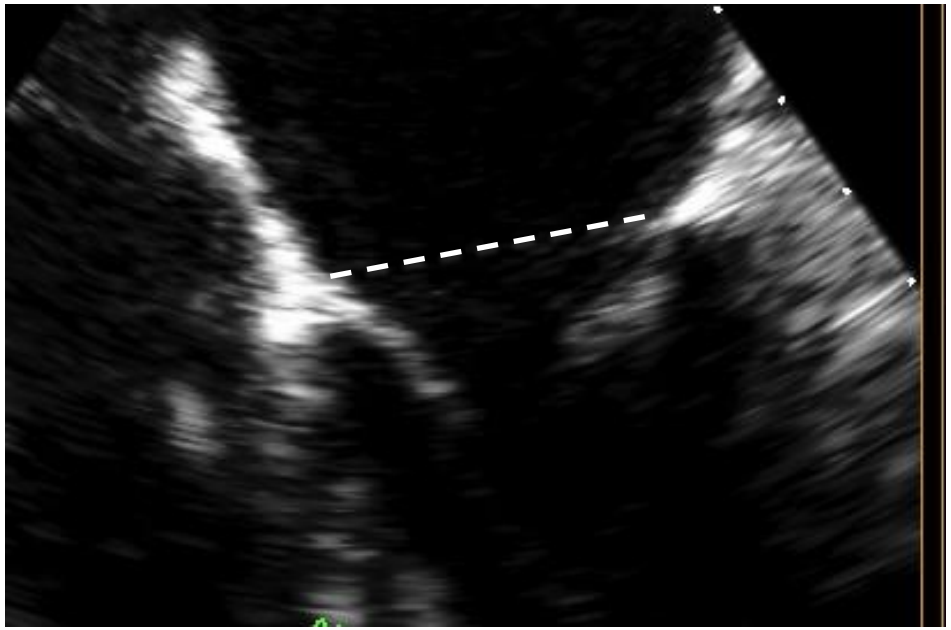
- **Calcifications of the leaflets**
- **Annular calcifications**
- **MV stenosis ( MV area > 4 cm2)**

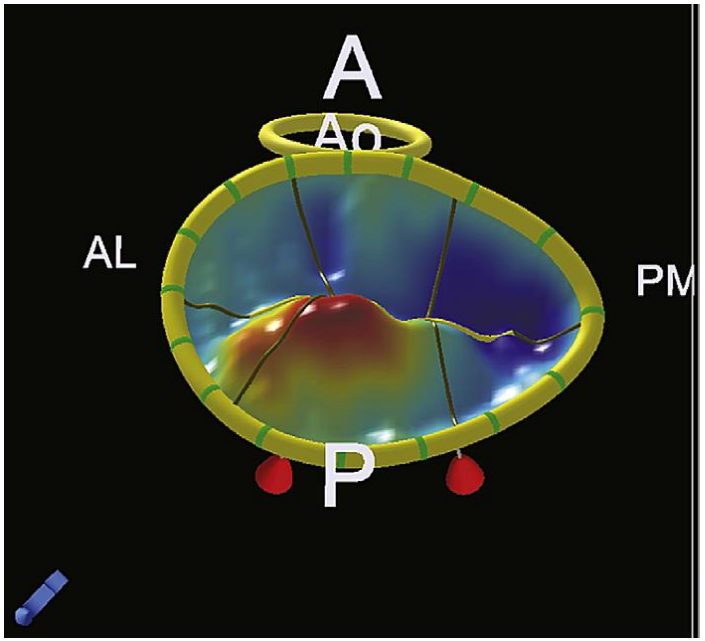




# Morphology of the valve

- **Annulus shape and dimensions**

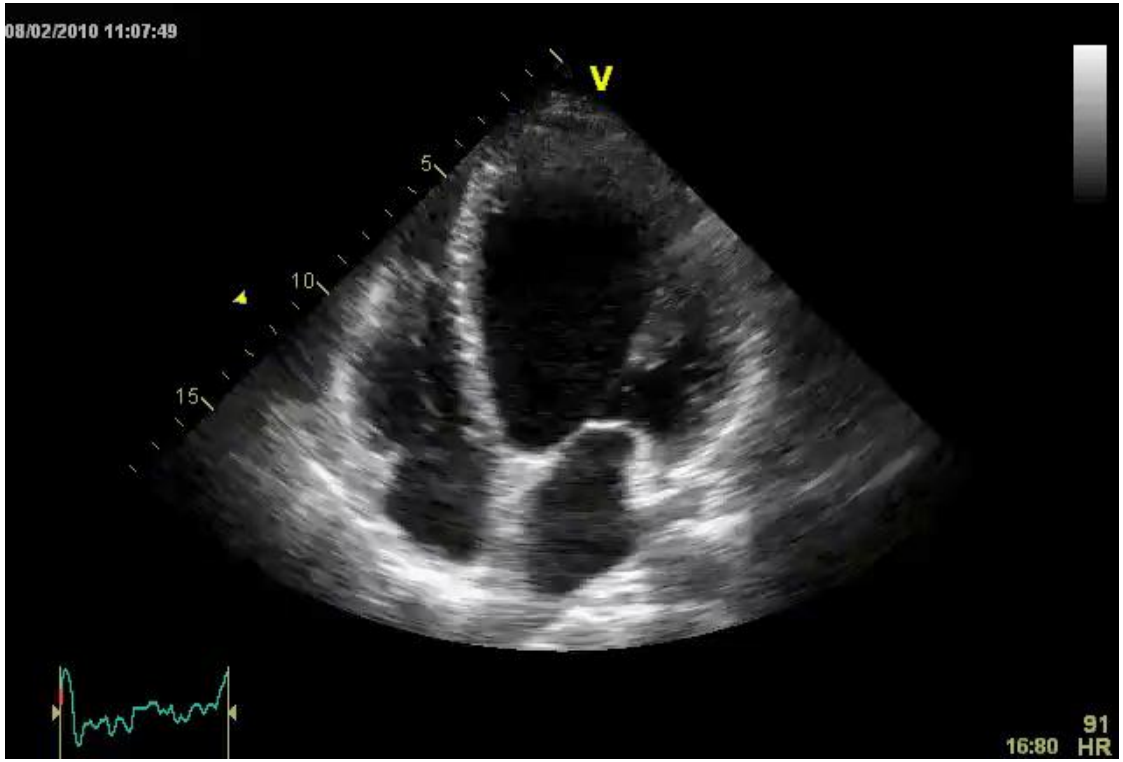





Salcedo J Am Soc Echocardiogr 2009;22:1087-99

# LV dimensions and function

- LV dimensions
- LV volumes
- EF
- Sphericity index
- Asynchronism
- Thrombus ?




Courtesy of E Donal

# Secundary MR

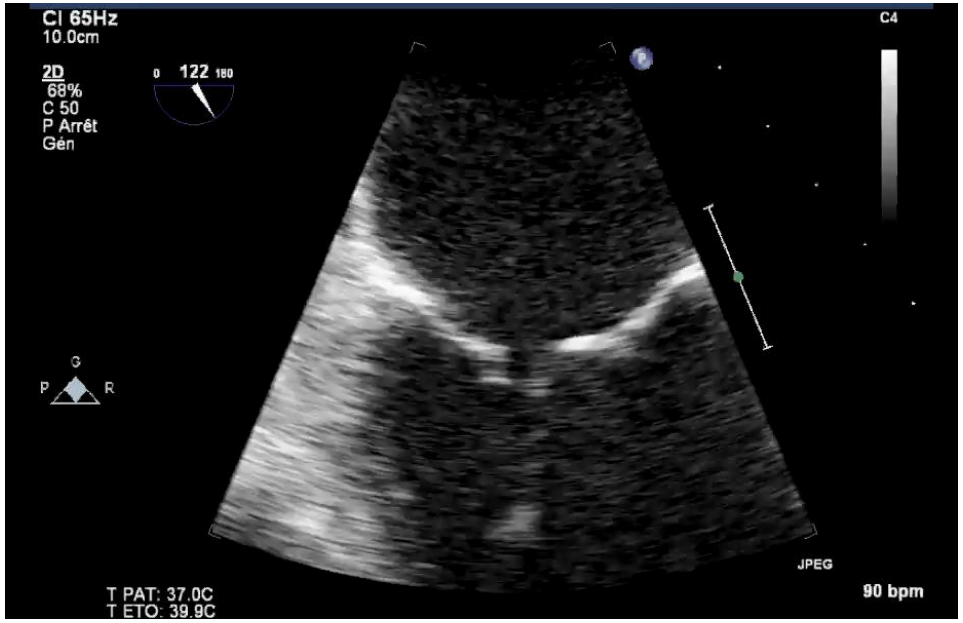
## Good candidates

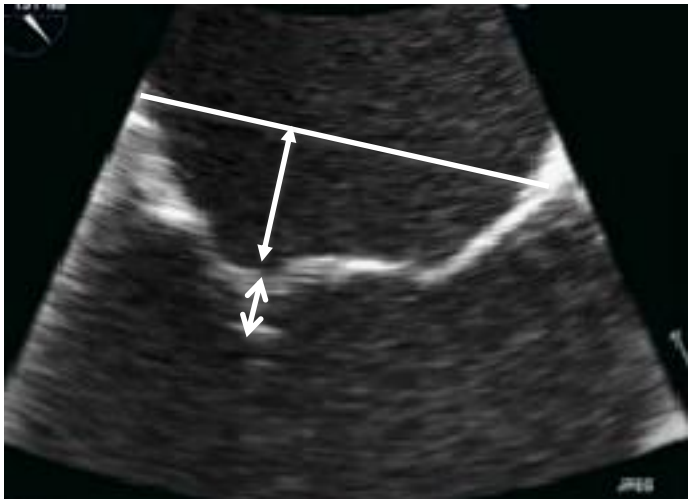
- Central MR jet
- Tenting height < 11 mm
- Coaptation length >2 mm
- Pliable valves
- Sufficient tissue for coaptation

## Poor candidates

- Severe valve deformation
- Mitral valve area < 4 $cm^2$
- Morphologic valve abnormalities
- Too severe LV dilatation or dysfunction (?)

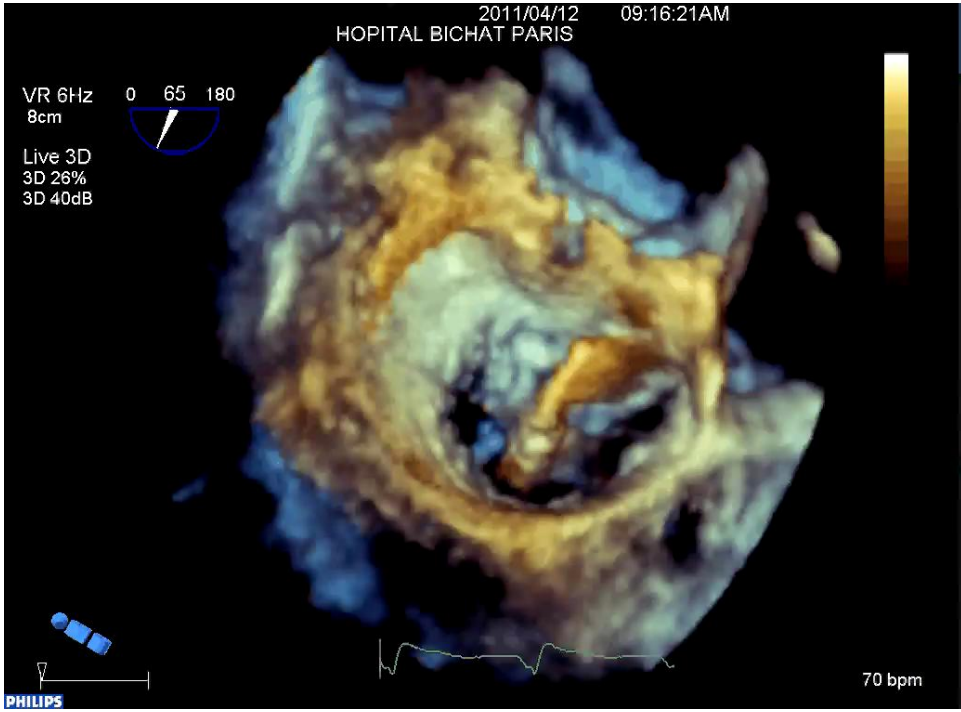
# Back to case

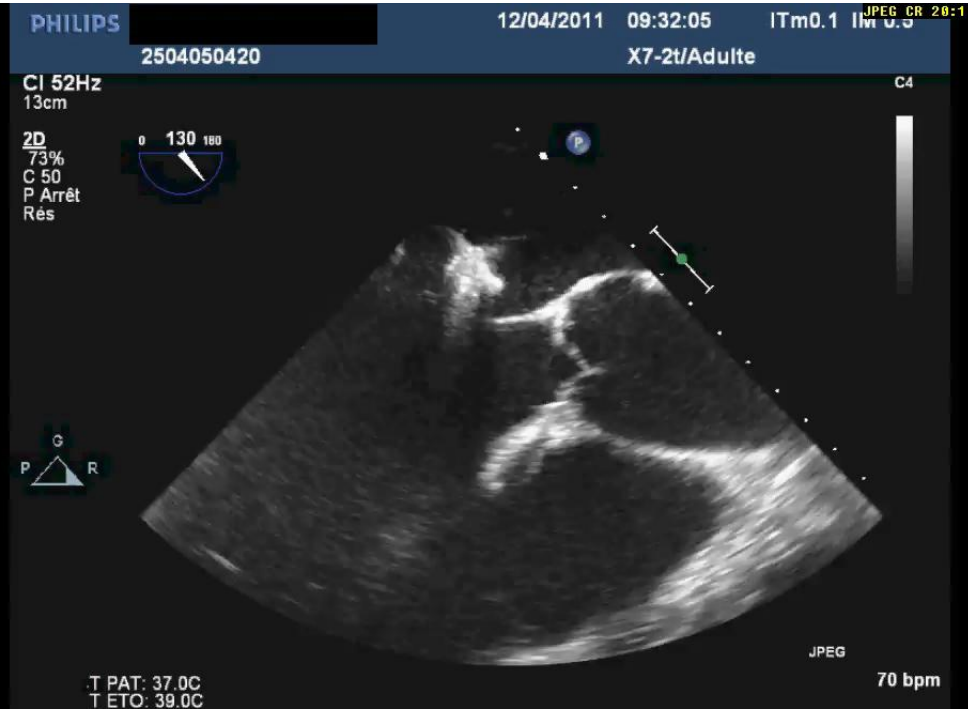


**Annulus diameter : 36 mm**
**Tenting depth : 11 mm**
**Coaptation length : 2 mm**
**MVA > 4 cm2**

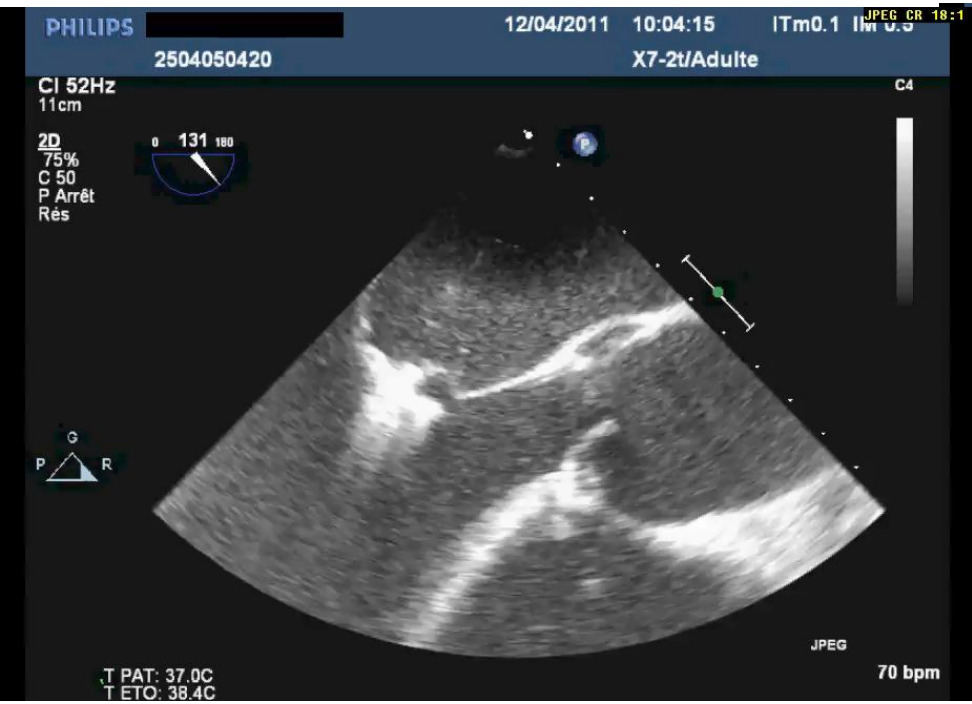
# What we did

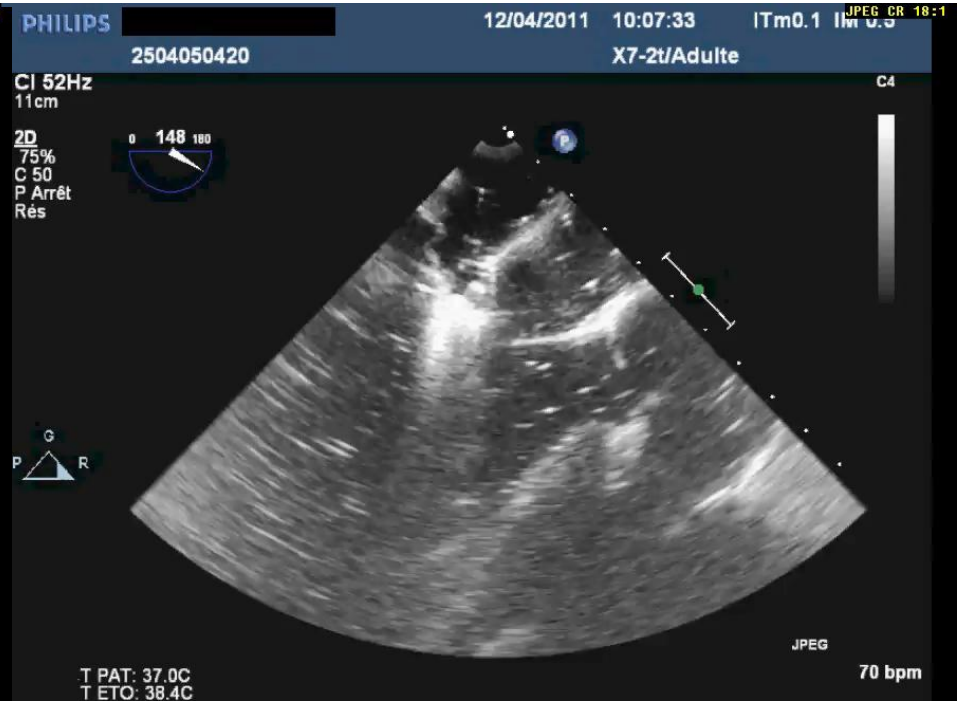



**Mitraclip procedure**

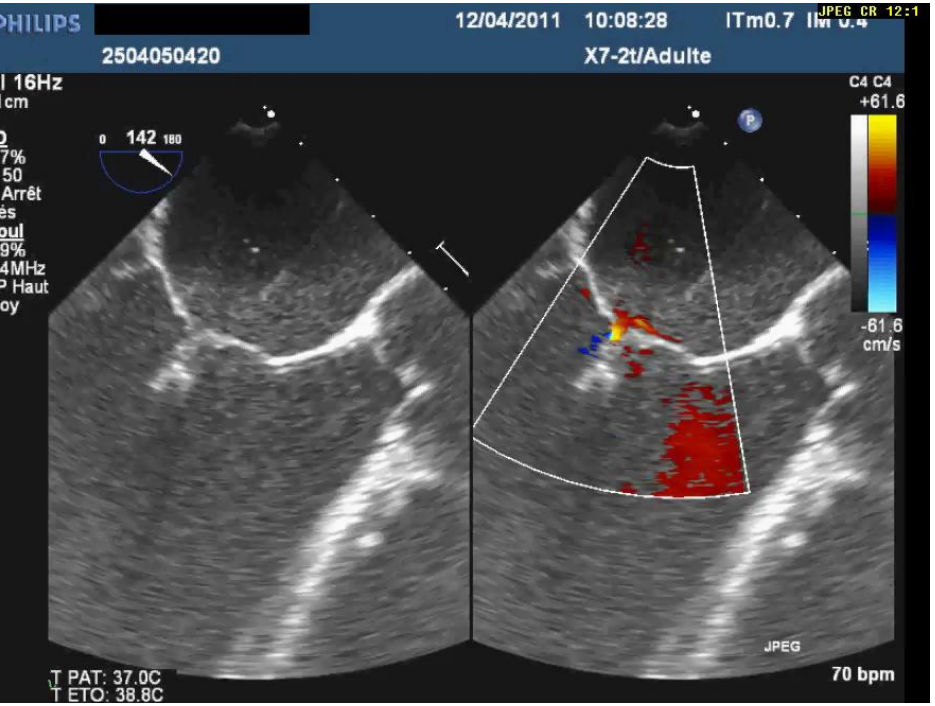
# Mitraclip procedure




**Leaflet grasp**

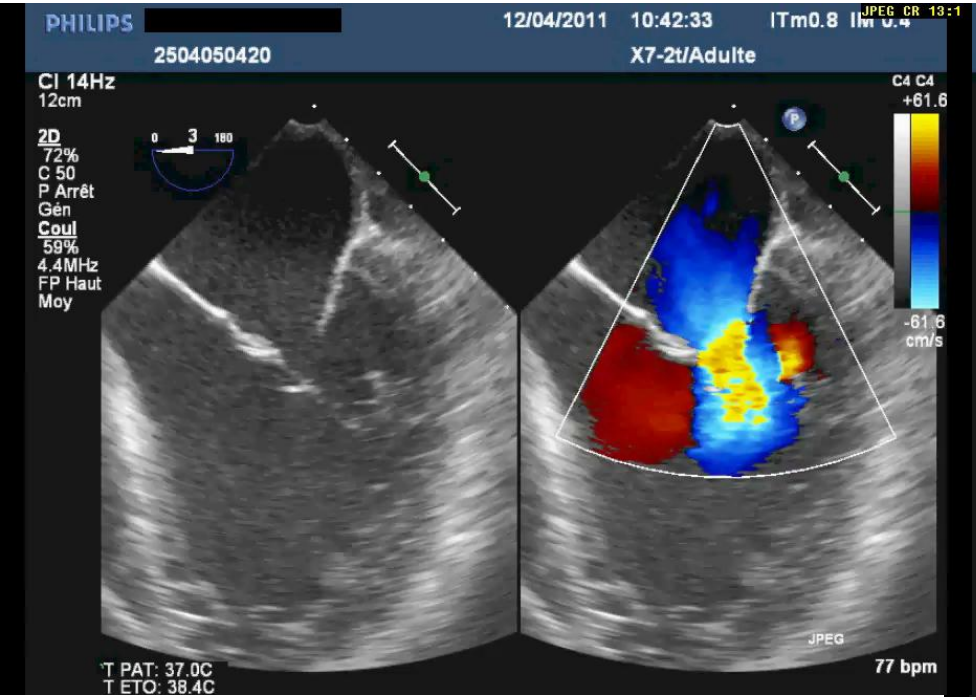
# Mitraclip procedure

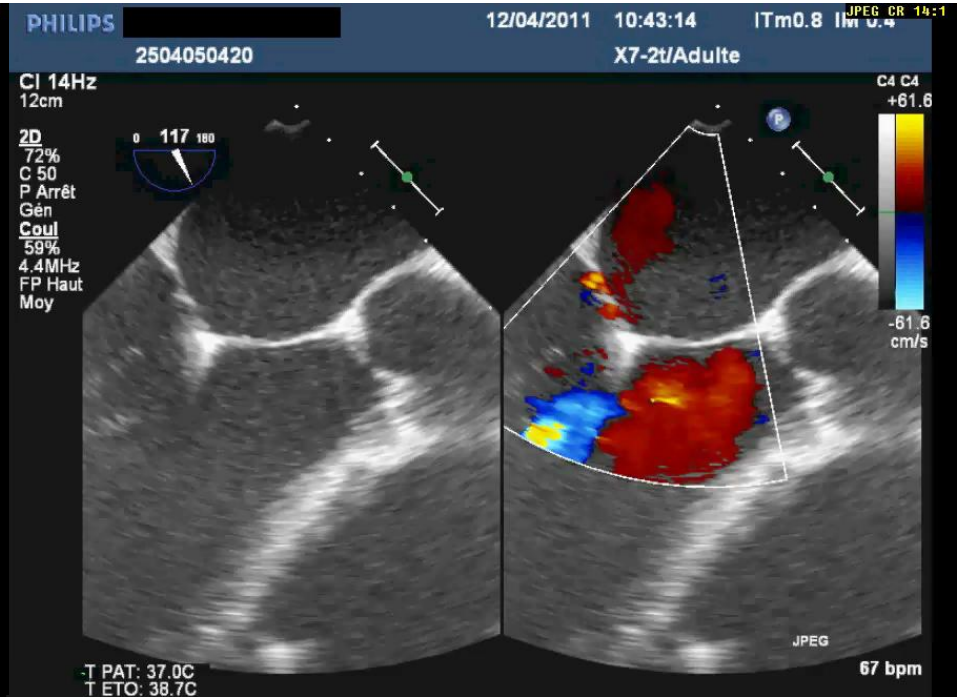




**Residual MR**

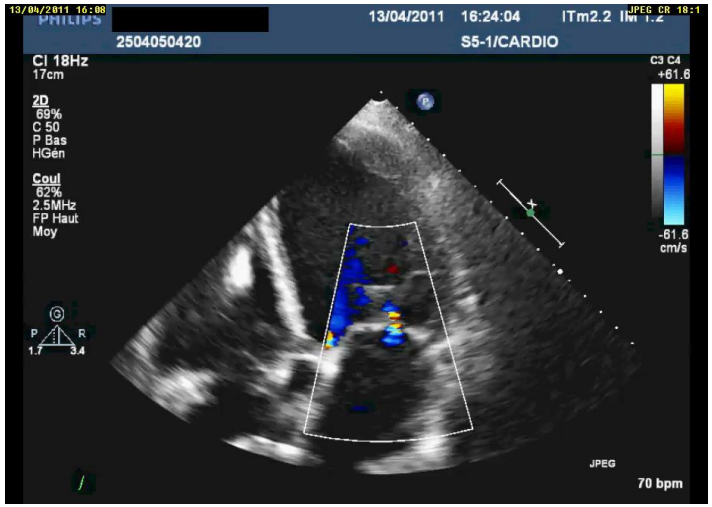
# Mitraclip procedure

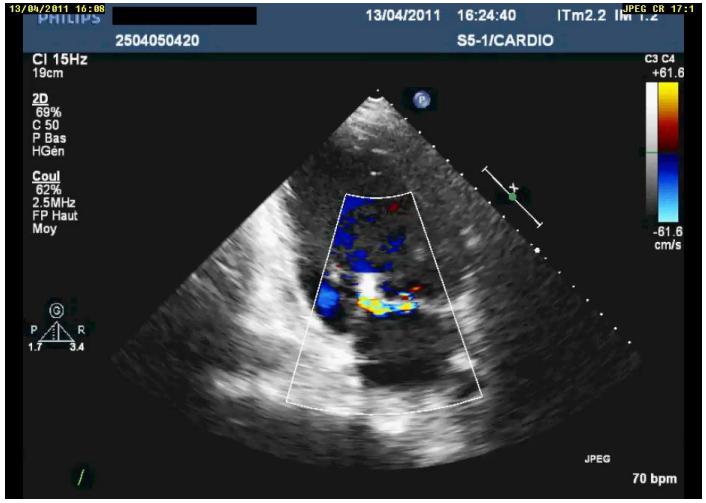


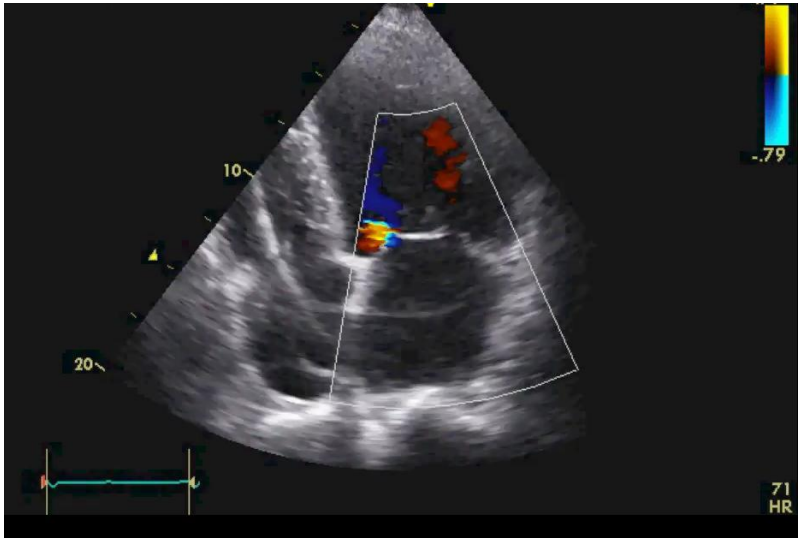




**Final result**

# Follow up



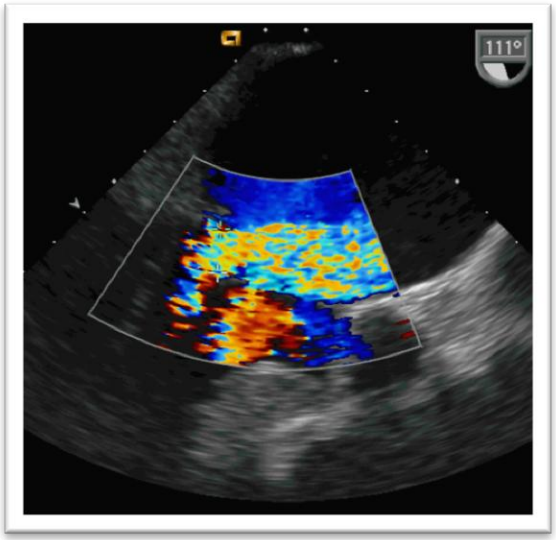

**NYHA class II**
**No reccurrence of CHF**
**LV EDV : 235 ml**
**LV ESV : 150 ml**
**EF: 0.35**
**SPAP: 45 mmHG**
**MR grade 1-2/4**

**Predischarge TTE**

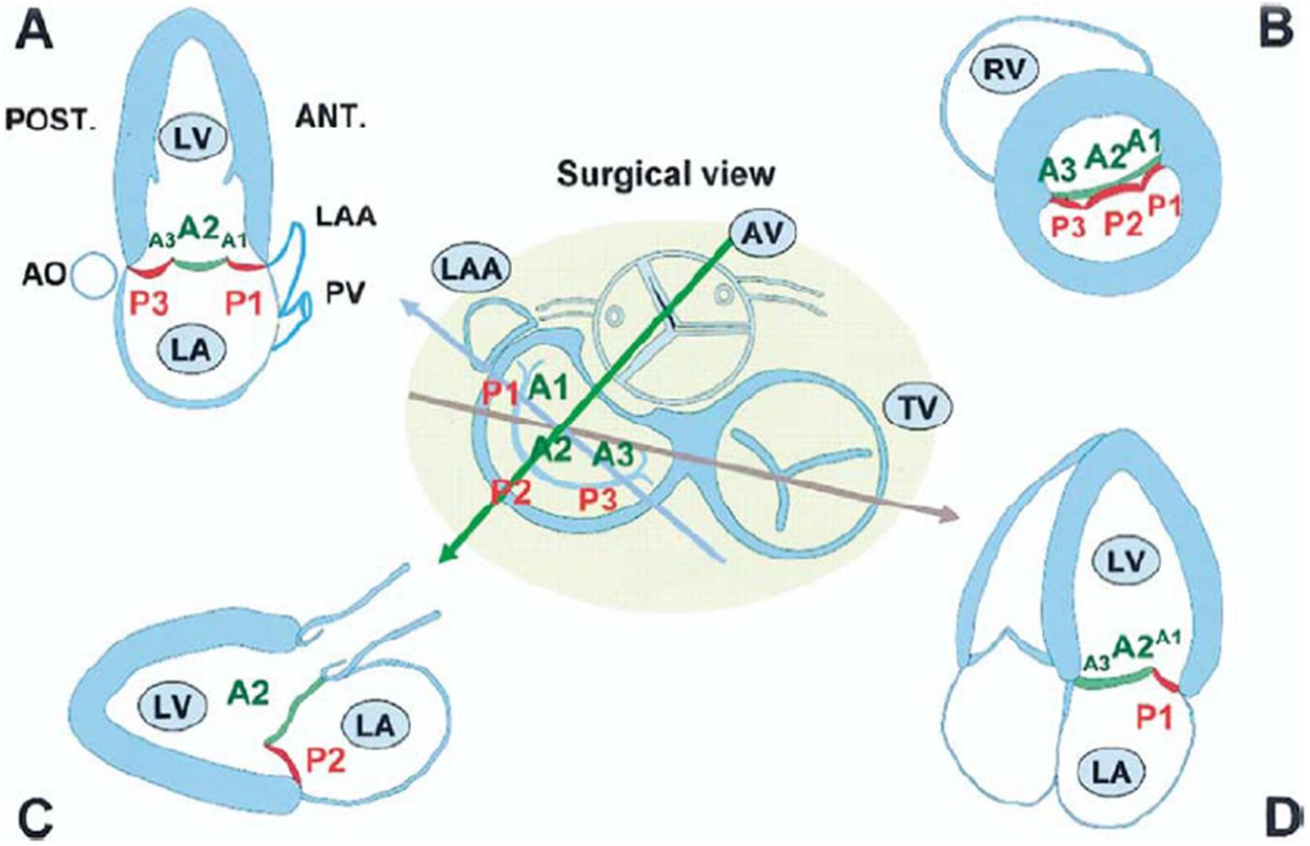
**1 Year FU TTE**

# Primary MR

- **Mitral valve prolapse**
- **Précise assessment**
  - **Uni or bivalvular**
  - **Topography (segmental analysis)**
  - **Extension (« flail »)**
  - **Chordal rupture**
  - **Specific measurements**



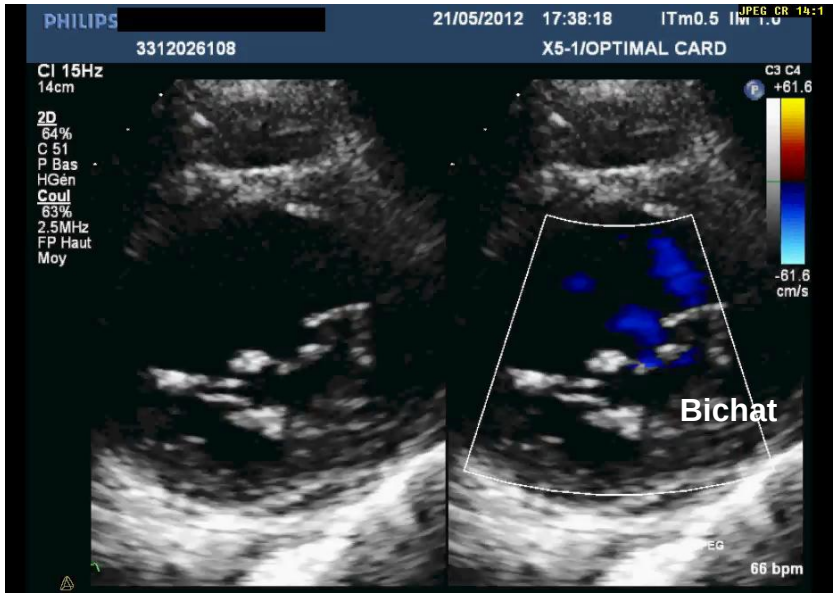
# Location of prolapse
# Role of 2D TTE

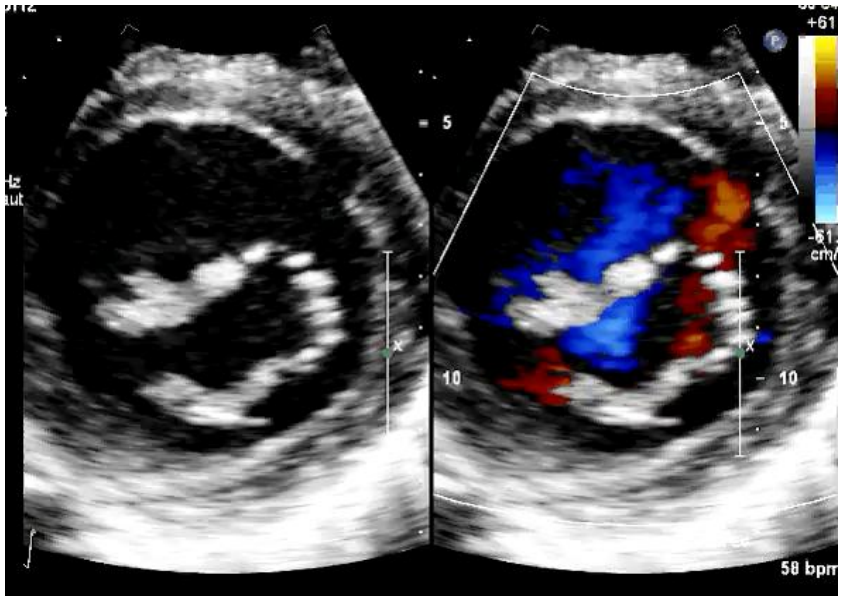



Monin et al. JACC 2005;46:302–9

# Primary MR

## MR jet should be central (A2P2)

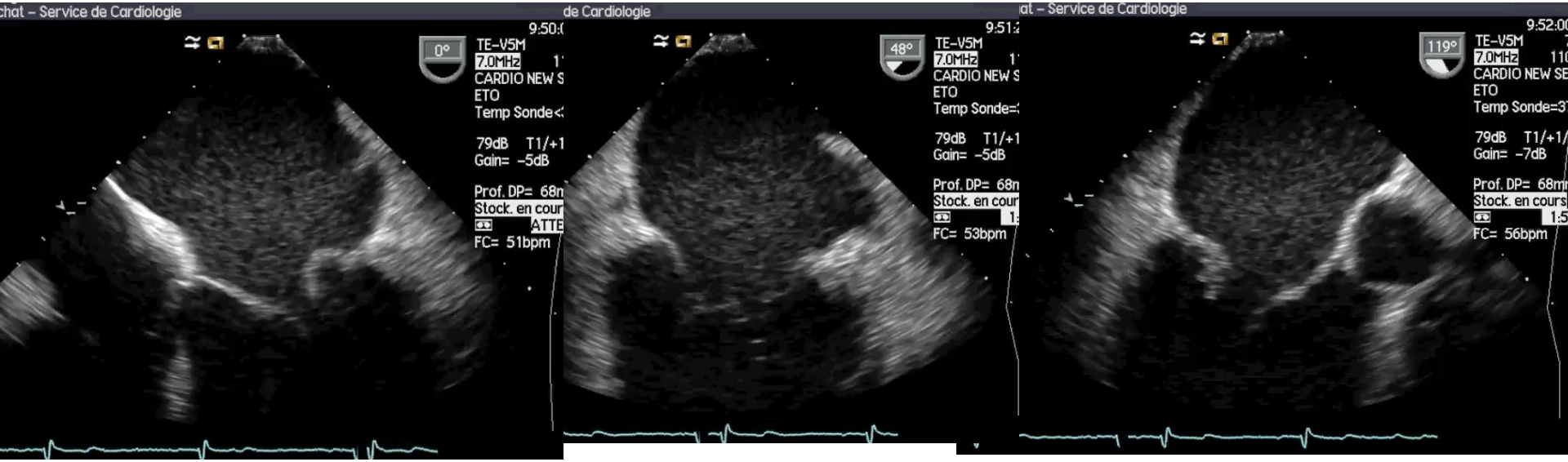


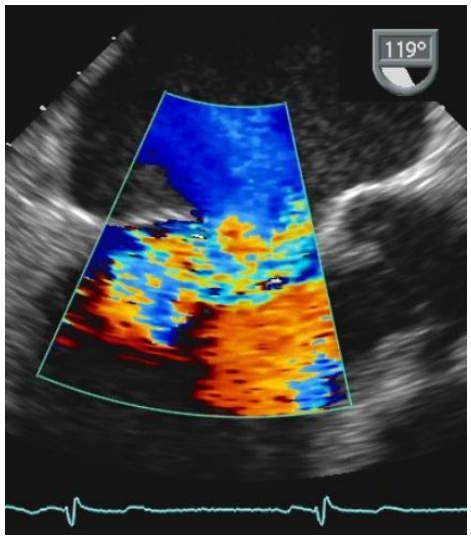




**SAX view of the MV**

# Localisation of MV prolapse

## Good candidates



**Type II**
**Organic (degenerative)**
**Ruptured chordae**
**P2 prolapse**

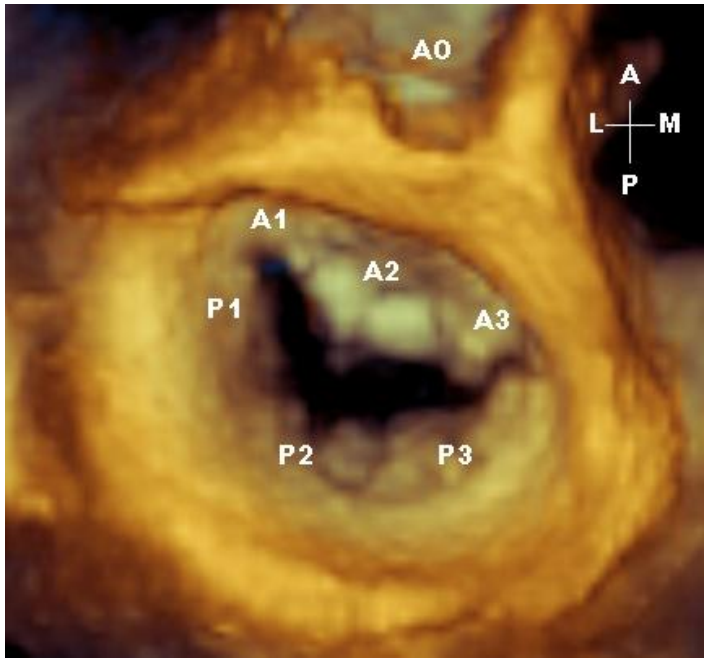
# Localisation of MV prolapse

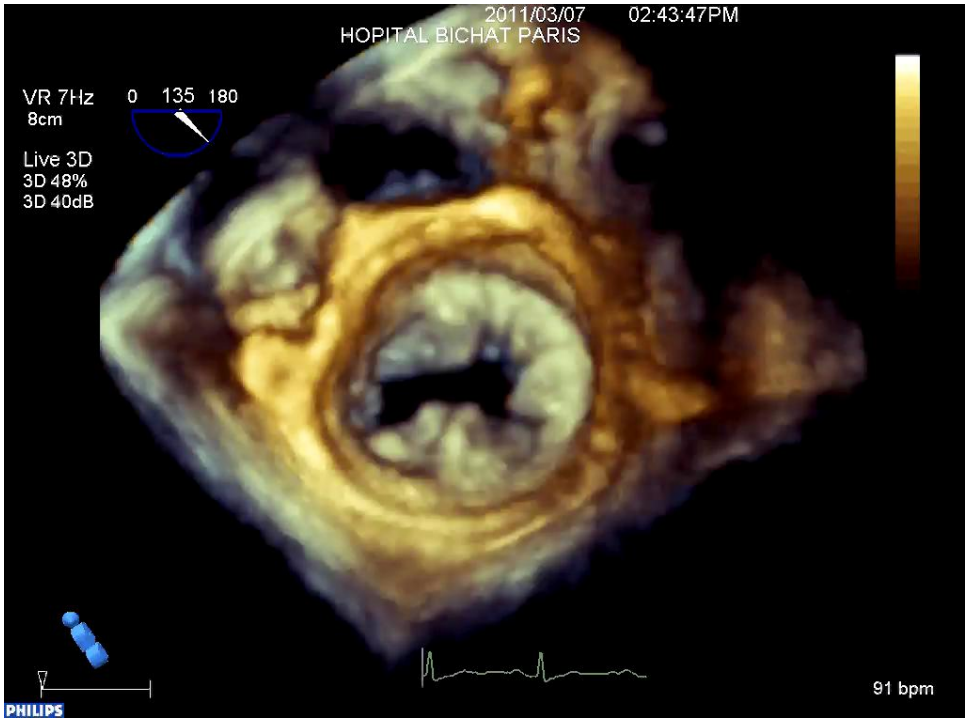
**Not candidate to Mitraclip**


**Type II**
**Severe bileaflet flail**
**Multiple chordal rupture**


**Type I+ II**
**Perforation**
**Commissural prolapse**

# Localisation of MV prolapse
# Role of 3D TEE

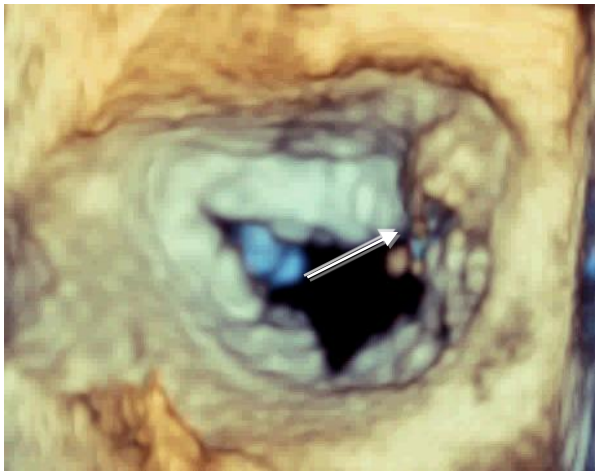


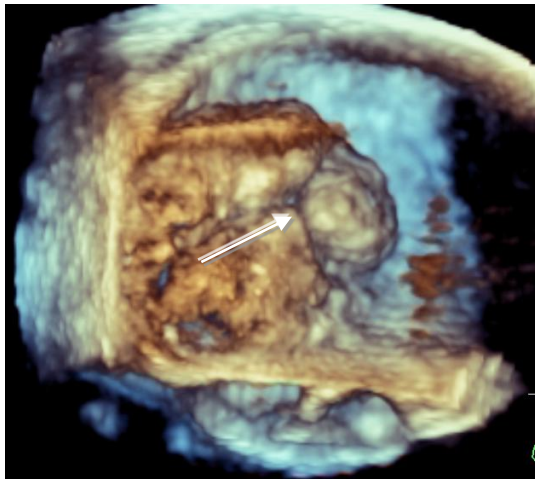




Biner S et al J Am Soc Echocardiogr 2011;24:611-7

# Localisation of MV prolapse

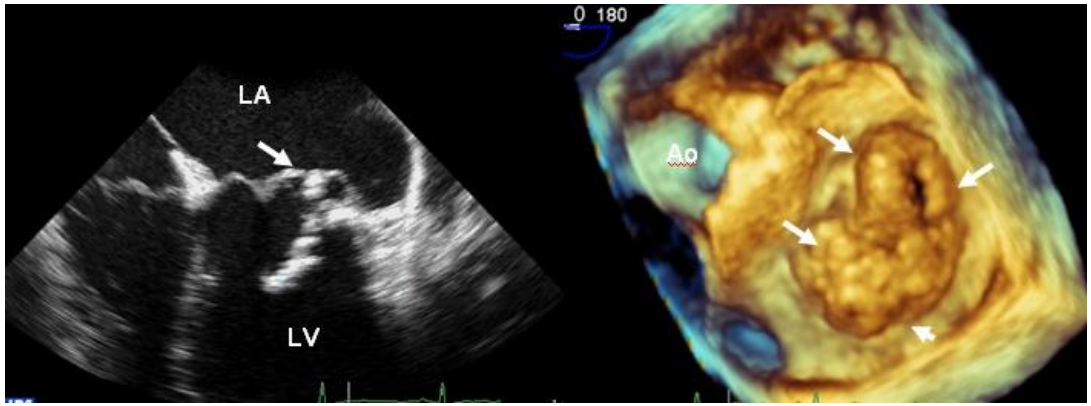
**Not candidate to Mitraclip**



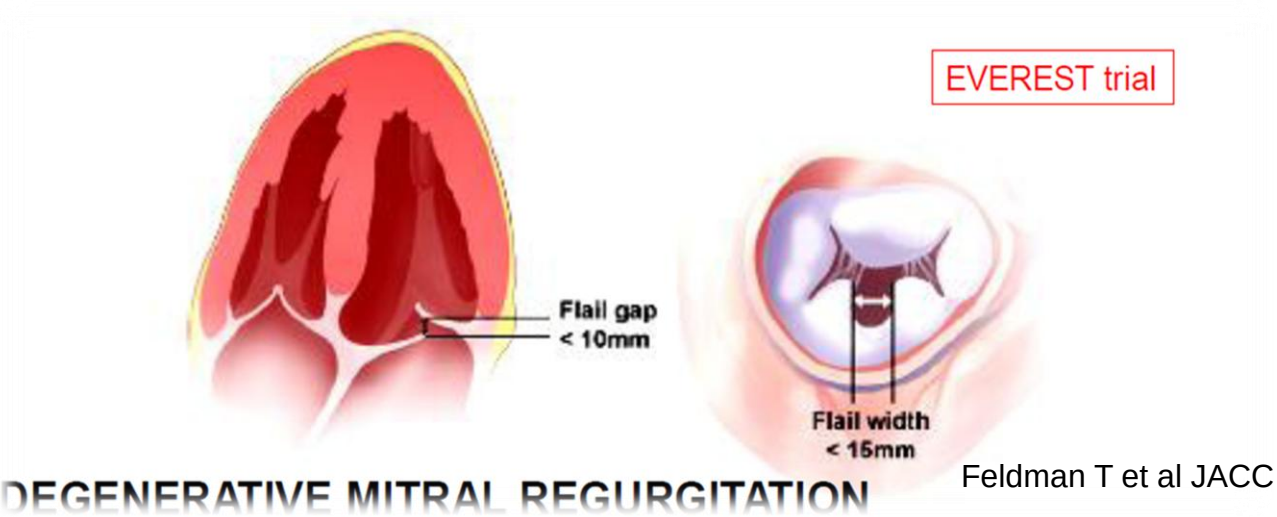


**Commissural prolapse**

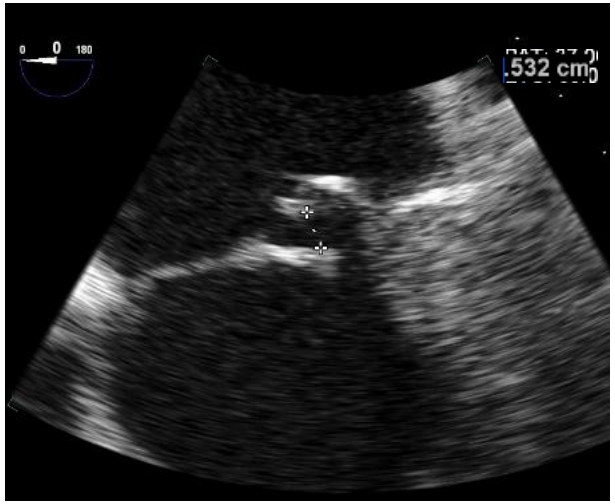
**Barlow's disease**



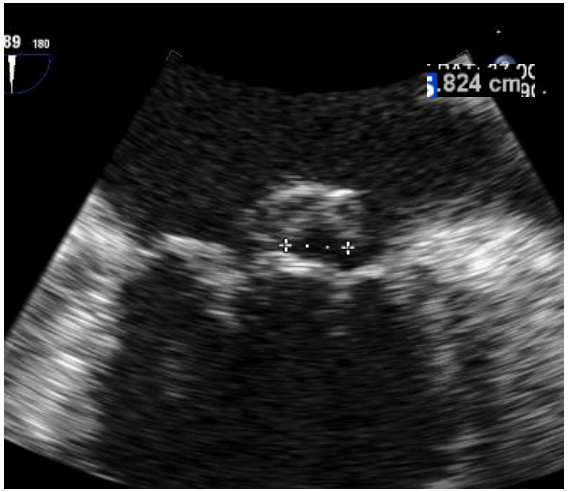
# Specific measurements




Feldman T et al JACC 2009; 54 :686-94

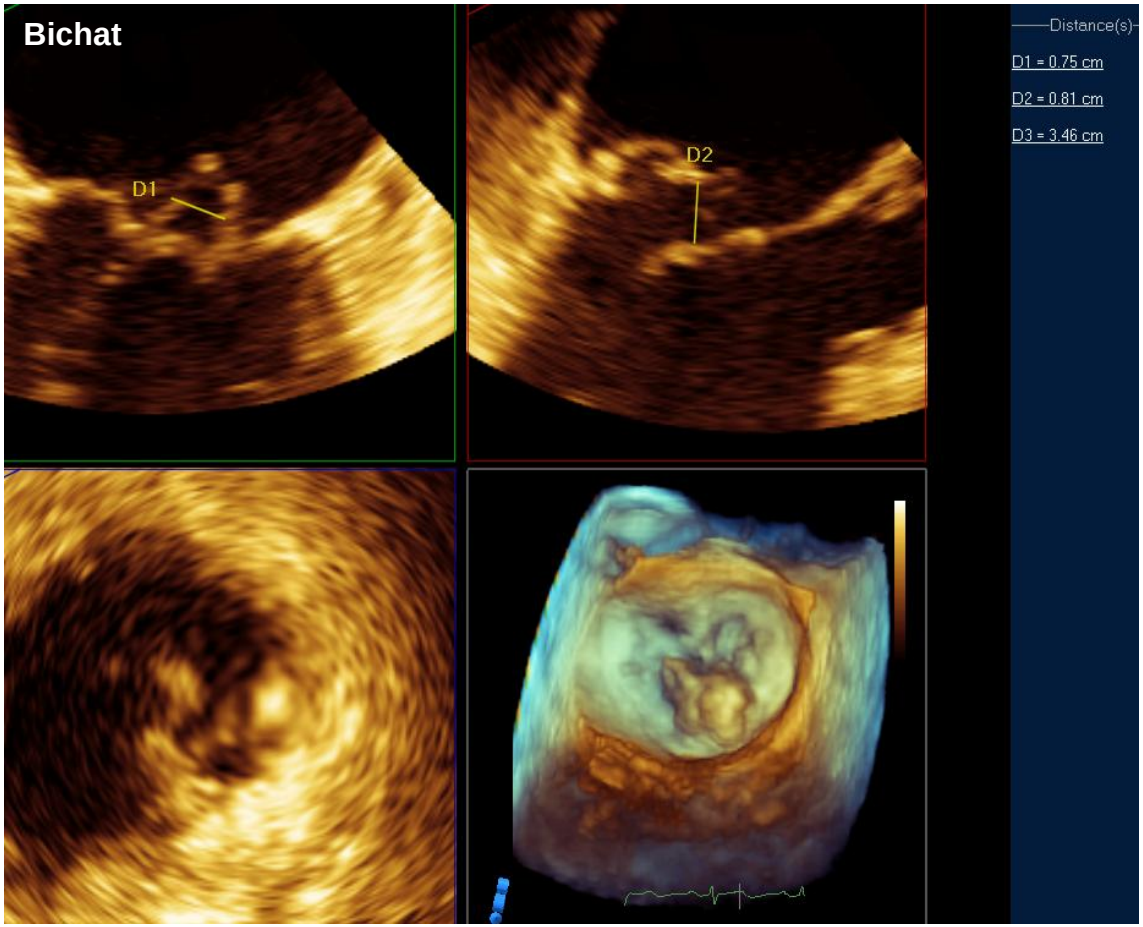


**Flail gap < 10 mm**



**Flail width < 15 mm**

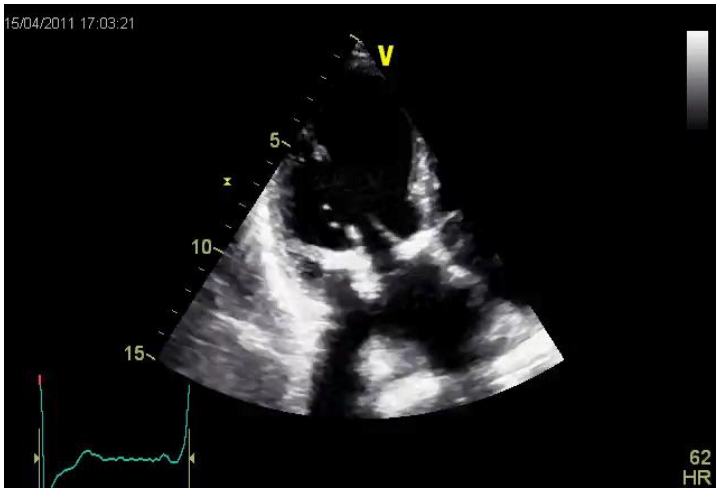
# 3D measurements of MV prolapse

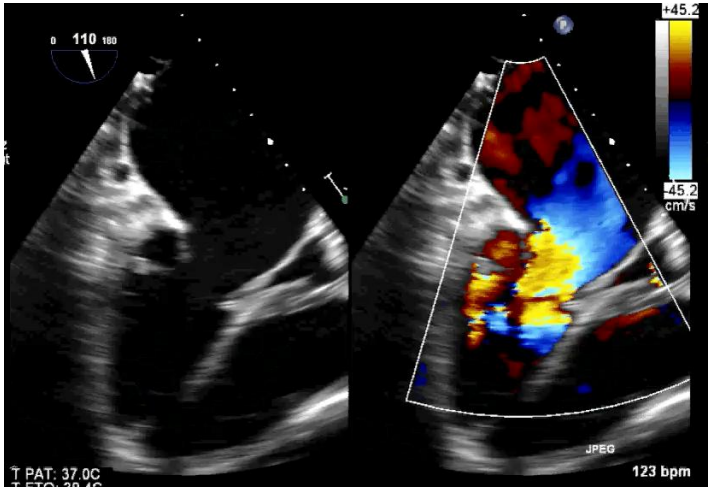



**RMP reconstruction**

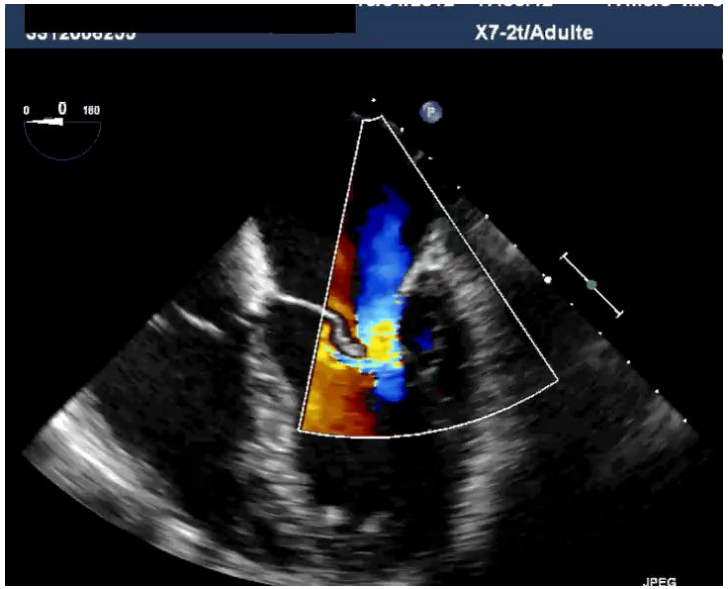
# Primary MR

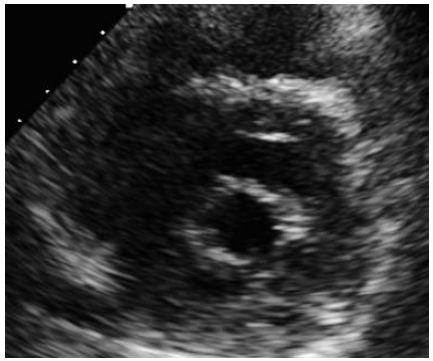
- **Exclusion criteria**
  - **Calcifications (annulus, leaflets)**
  - **Restrictive posterior leaflet (short PVM)**
  - **Rheumatic MR**
  - **Endocarditis**
  - **MV perforation**
  - **MVA < 4cm2**
  - **Extensive flail**
  - **Leaflet cleft**

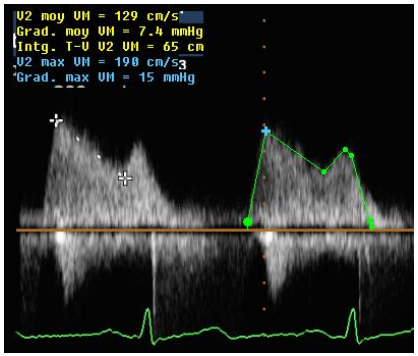


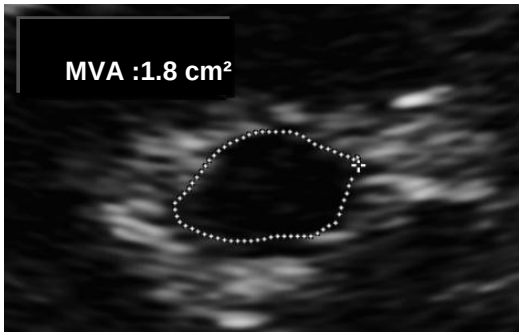



# Morphology of the MV




**Rheumatic MR**

# Primary MR

## Good candidates

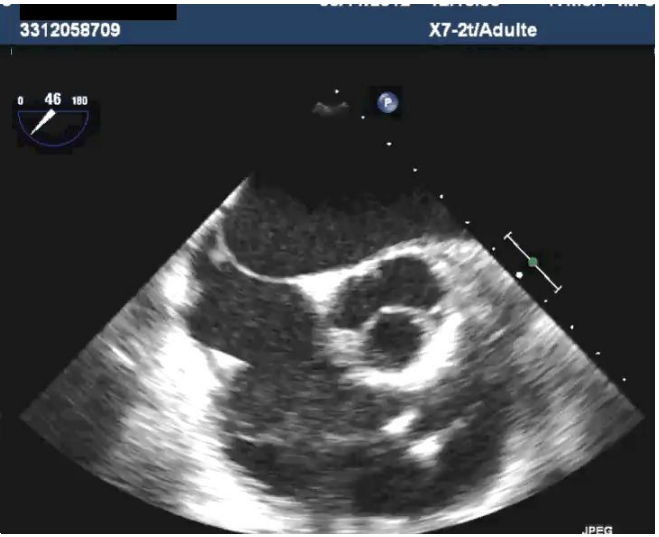
- A2 or P2 prolapse
- Central MR jet
- Flail gap < 10 mm
- Flail width < 15 mm
- Sufficient tissue for coaptation
- Mitral valve area > 4 $cm^2$

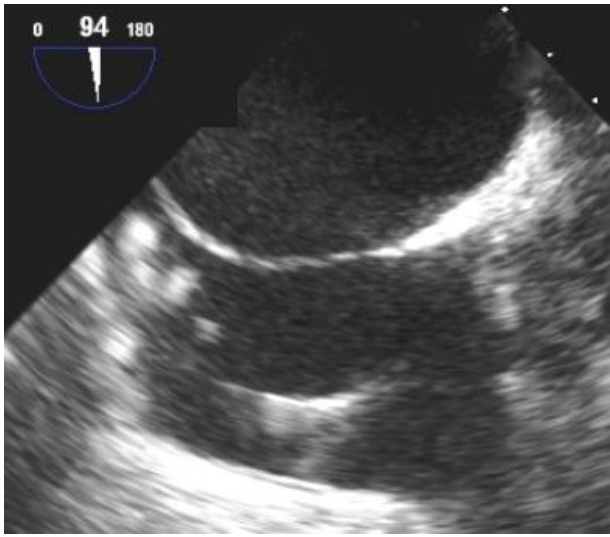
## Contra indications

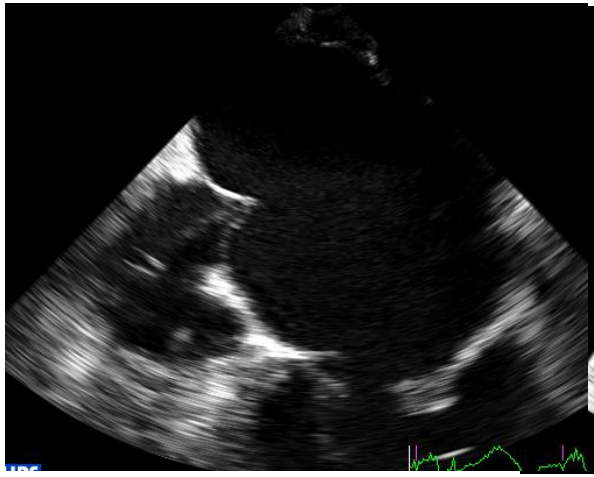
- Endocarditis, Rheumatic origin
- Calcifications of leaflets/annulus
- Extensive bileaflet prolapse
- Commissural prolapse
- Insufficient leaflet length for coaptation
- Mitral valve area < 4 $cm^2$

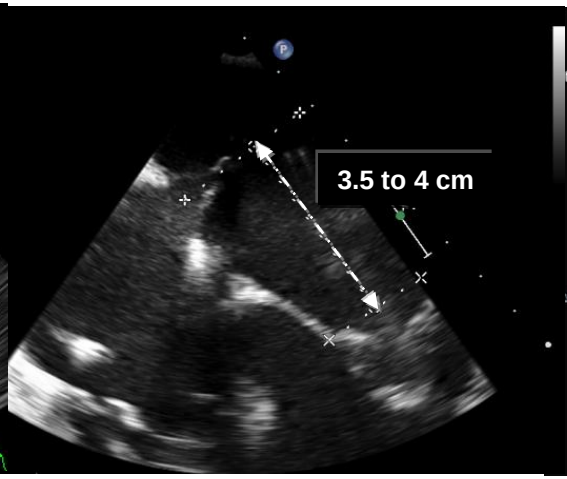
# Additional parameters

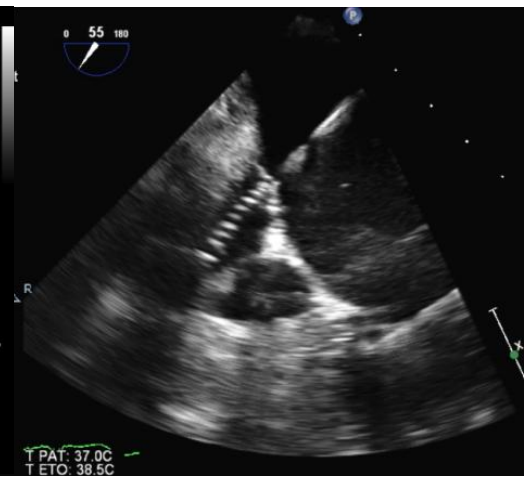
- Interatrial septum

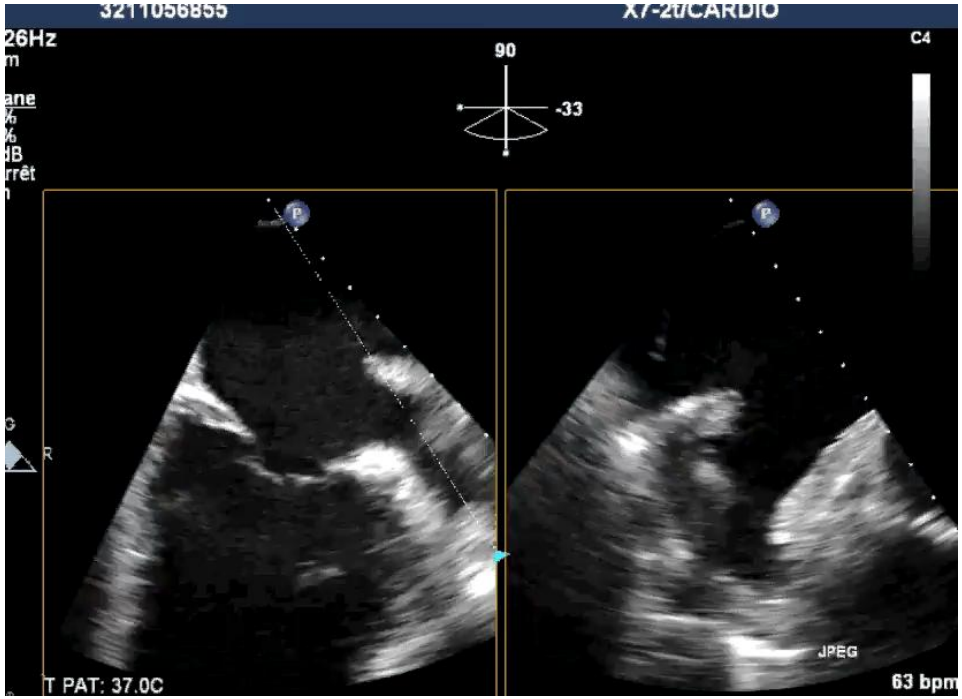



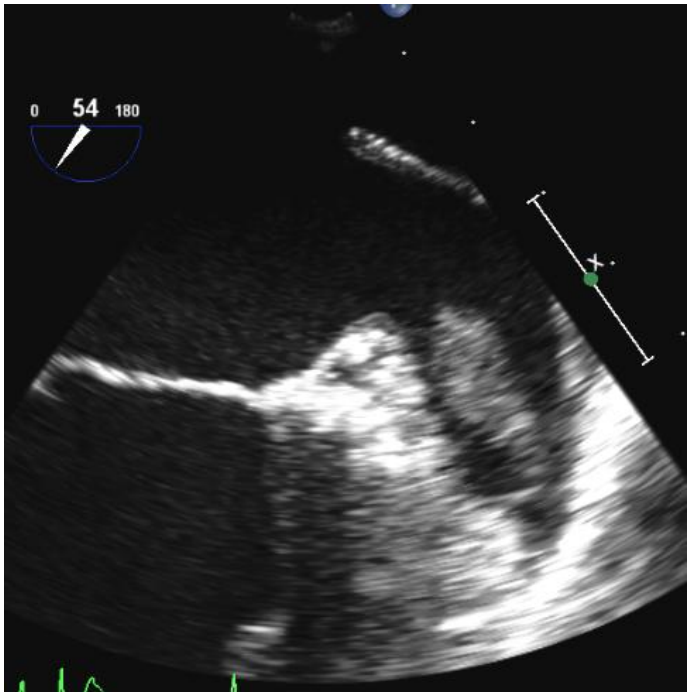


# Additional parameters

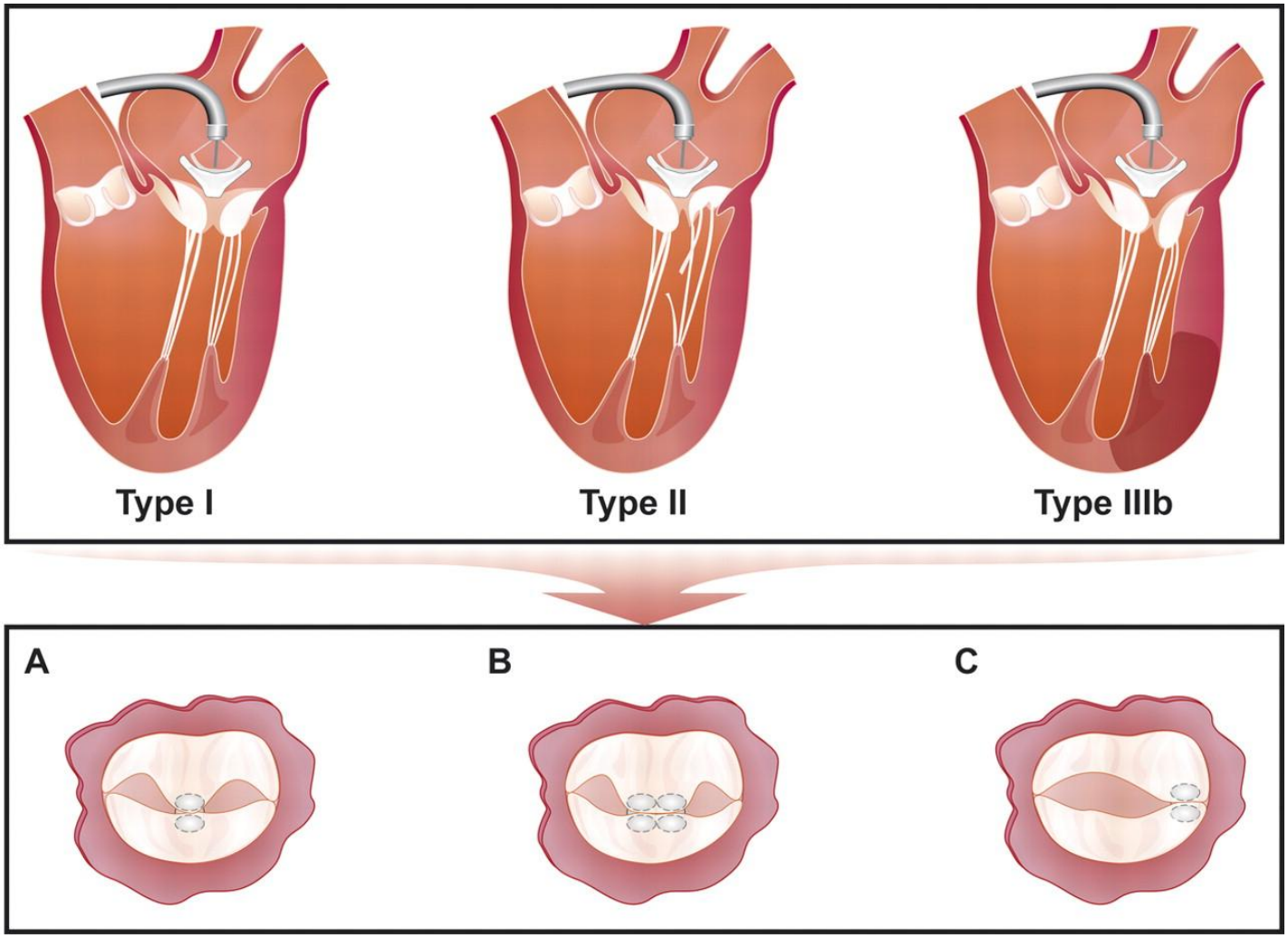
- **Left atrial appendage**




**LAA thrombus**

# Spectrum of pathologies treatable with the MitraClip



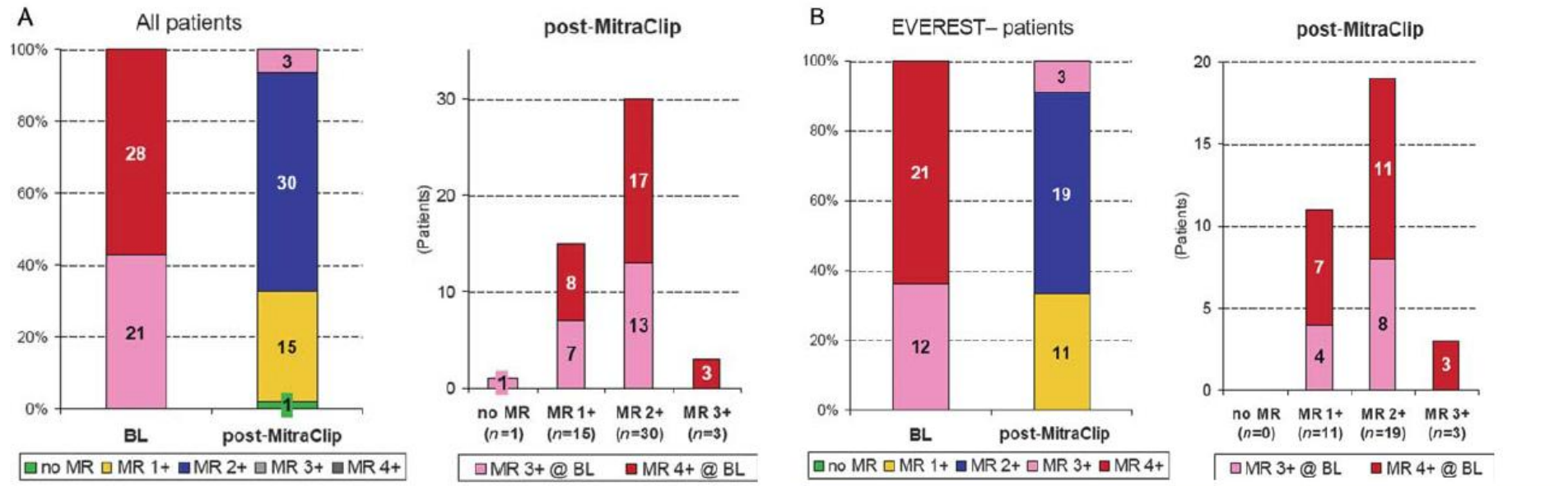

Rogers J H , Franzen O Eur Heart J 2011;eurheartj.ehr101



European Heart Journal

# Acute outcomes of MitraClip therapy for mitral regurgitation in high-surgical-risk patients: emphasis on adverse valve morphology and severe left ventricular dysfunction

Olaf Franzen[1]*, Stephan Baldus[1], Volker Rudolph[1], Sven Meyer[1], Malgorzata Knap[1], Dietmar Koschyk[1], Hendrik Treede[2], Achim Barmeyer[1], Joachim Schofer[3], Angelika Costard-Jäckle[1], Michael Schlüter[1], Hermann Reichenspurner[2], and Thomas Meinertz[1]




In 35 patients (69%), adverse mitral valve morphology and/or severe LV dysfunction were present.

**European Heart Journal (2010) 31, 1373–1381**

# Summary

- **Growing use of Mitraclip (> 6000 procedures worldwide)**
- **Patient selection**
    - **Multidiciplinary clinical decision ( Heart team)**
    - **Importance of  anatomy and function assessment**

- **Major role of echo, including all echo modalities, 2D TTE, TEE and  RT 3D TEE**
  - **Particular attention to valve morphology, location and severity of MR jet and mechanisms of MR**
  - **Specific measurements for feasibility assessment**

# Summary

- **What we need to improve selection**
  - **Refinements of anatomic criteria proposed at the beginning of experience**
  - **Large series, registries and randomized studies especially in functional MR**

# Thank you