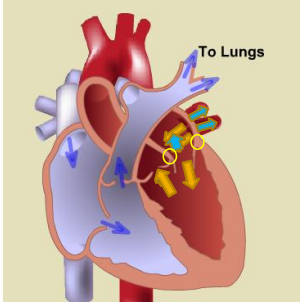
Echocardiography in Mitral Valve Interventions

Areas Covered

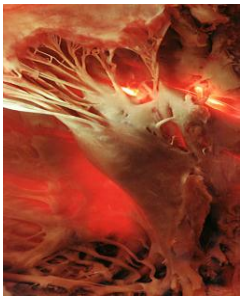
- Mitral Stenosis
  - Balloon Mitral Valvuloplasty
- Percutaneous Closure of Paravalvular leaks
- Mitral Clip for Mitral Insufficiency

The Normal Mitral Valve



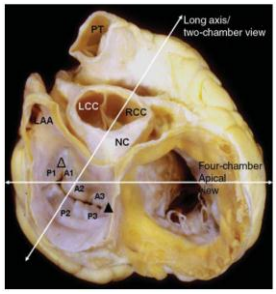
The Normal Mitral Valve

- Anatomy
  - Leaflets
  - Annulus (AV junction)
  - Chordae tendineae
  - Papillary muscles



The Normal Mitral Valve – "Surgical" View

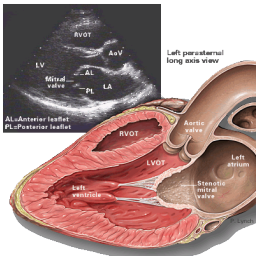
- Posterior (mural) leaflet
  - 2/3 around AV junction
  - 3 scallops related to indentations
- Anterior (aortic) leaflet
  - 1/3 annular circum
  - Broader
- Carpentier's nomencl:
  - Lateral (A_1, P_1) – anterolateral commisure
  - Central (A_2, P_2)
  - Medial (A_3, P_3) – posteromedial commisure

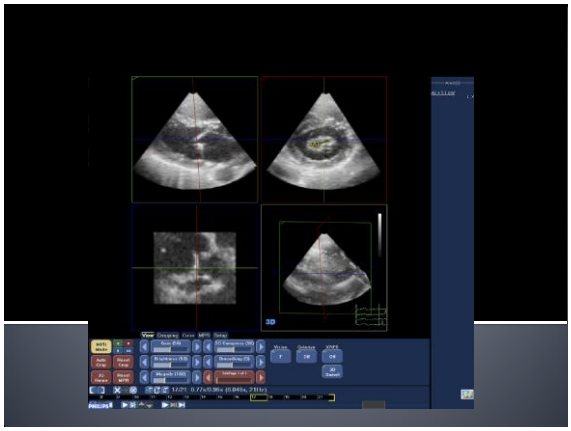


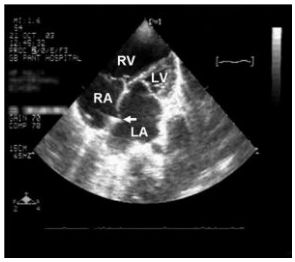
Mitral Stenosis

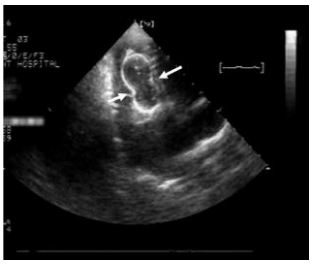
Mitral Stenosis

- Anatomy of a Stenotic Mitral Valve
  - Thickened leaflets with reduced mobility
  - Calcification
  - Thickened, fused chordae









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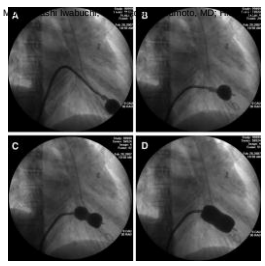

EAE/ASE recommendations for the use of echocardiography in new transcatheter interventions for valvular heart disease

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(ASE): The ASE Guide

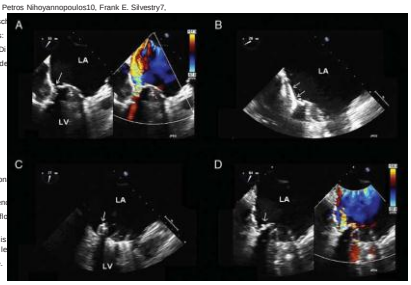


Figure 20 Two-dimension
regurgitation.
(A) The area of dehiscen
regurgitation by colour-flo
is open.
(D) The closure device is
regurgitation. LA, le
atrium; LV, left ventricle.

Figure 22 Transesophageal three-dimensional view of a mechanical mitral bileaflet prosthetic valve from the atrial perspective. (A) The dehiscence (arrow) at the posterior aspect of the valve ring is seen. (B) The guide wire (arrows) has been passed through the dehiscence.
(C) Following deployment of the first occluder, which is guide wire has been positioned to guide placement of a second occlude for residual regurgitation (not shown). (D) At the conclusion of the procedure, two adjacent occluders are present (double arrows). *AV*, aortic valve.

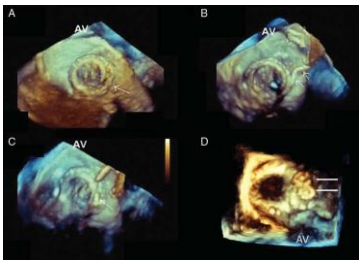


Figure 25 Real-time three-dimensional image from a left atrial perspective showing the path of the guide wire (arrow) as it passes through the interatrial septum (top), across the left atrium and through the paravalvular defect.

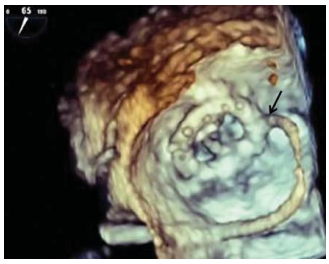


Figure 28 Three-dimensional transesophageal echocardiography image from a left atrial perspective demonstrating three closure devices (arrows) surrounding a bileaflet mitral prosthesis.

Echo in Balloon Mitral Valvuloplasty

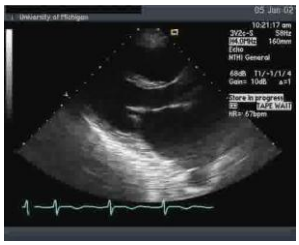
- Mitral Valve Assessment for Balloon Valvuloplasty
  - Assess for Mitral Insufficiency severity
  - Wilkins (Block) Score
    - Leaflet Mobility 1-4 points
      - 1 = Highly mobile; only tips of MV are restricted
      - 2 = Middle and base of leaflets are mobile
      - 3 = Valve motion identified in diastole, mainly at base
      - 4 = No or minimal movement of leaflets in diastole
    - Leaflet Thickening 1-4 points
    - Leaflet Calcification 1-4 points
    - Subvalvular Thickening 1-4 points

Echo in Balloon Mitral Valvuloplasty

- Wilkins Score – Predictions for successful balloon valvuloplasty
  - 0-8 points – Good candidate
  - 9-12 points – Intermediate Results
  - > 12 points – Poor candidate

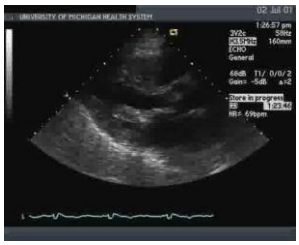
Echo in Balloon Mitral Valvuloplasty

- Acceptable candidate



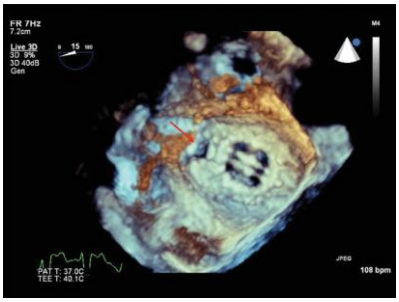
Echo in Balloon Mitral Valvuloplasty

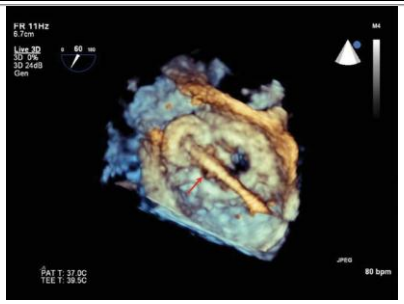
- Suboptimal candidate

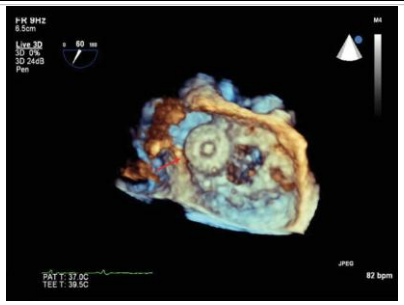


Mitral Perivalvular Insufficiency

3D


FR 7Hz
7.2cm
Live 3D
3D 9%
3D 40dB
Gen
M4
PAT T: 37.0C
TEE T: 40.1C
JPEG
108 bpm


FR 11Hz
6.7cm
Live 3D
3D 9%
3D 24dB
Gen
M4
PAT T: 37.0C
TEE T: 38.5C
JPEG
80 bpm

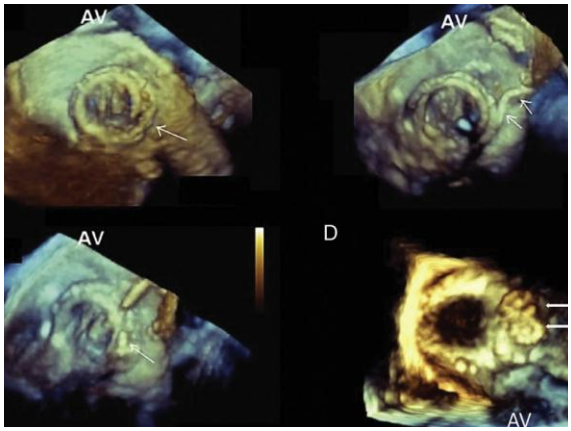

FR 9Hz
8.5cm
Live 3D
3D 0%
3D 24dB
Pen
M4
PAT T: 37.0C
TEE T: 38.5C
JPEG
82 bpm

Echo Guidance in Mitral Perivalvular Insufficiency

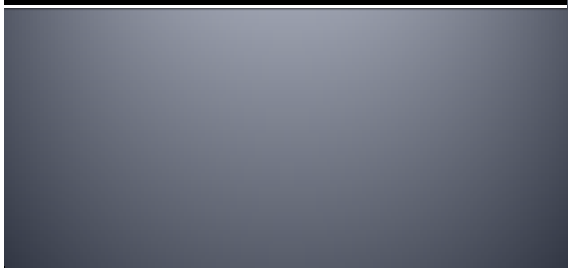
- Pre-procedural assessment
  - TEE
    - Assess location and severity of perivalvular insufficiency
  - 3D imaging to provide interventionalist anatomy and orientation of defect
    - Watch to avoid 3D "drop out" by caused by low gain settings
    - Use color mapping confirmation
  - Size defect by 3D to aid in choice of device/size
  - Exclude intracardiac and prosthetic thrombi

Echo Guidance in Mitral Perivalvular Insufficiency

- Procedural guidance
- Guidance of transeptal puncture (for antegrade approach)
- Assess seating of closure device
- Assess function of prosthetic valve post implantation
- Determine presence and quantify residual perivalvular insufficiency



Mitral Insufficiency



The AB-normal Mitral Valve

- Complete closure (coaptation) and correct apposition (4-5mm of symettric overlap) is essential in preventing regurgitation
- Etiologies of mitral regurgitation
  - Degenerative (60%)
  - Rheumatic; post inflammatory (12%)
  - Functional (25%)
  - Congenital, endocarditis, etc

Echocardiographic Assessment for Mitral Clip in Mitral Insufficiency

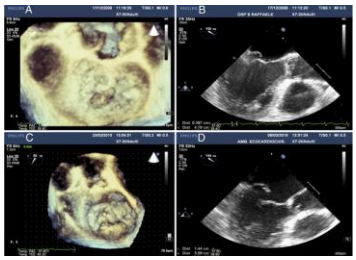
- Mitral Insufficiency
  - Best options are surgical
    - Repair
    - Replacement
  - Non-candidates for surgery have a high morbidity and mortality rate
- Non-surgical options
  - Indirect annuloplasty via coronary sinus
  - Direct annuloplasty – radiofrequency, transventricular suture
  - Ventricular remodeling
  - Mitral leaflet repair

Echocardiographic Assessment for Mitral Clip in Mitral Insufficiency

- Patient selection
  - Important to understand and be able to identify the six segments of the mitral valve in order to localize the site(s) of origin of mitral insufficiency
    - FIG?
    - Mitral Annulus geometry – 3D slide
  - Predominant mechanism should be MR from the region of A2-P2
  - Anatomy must be amenable to the grasping of the diseased mitral valve leaflets

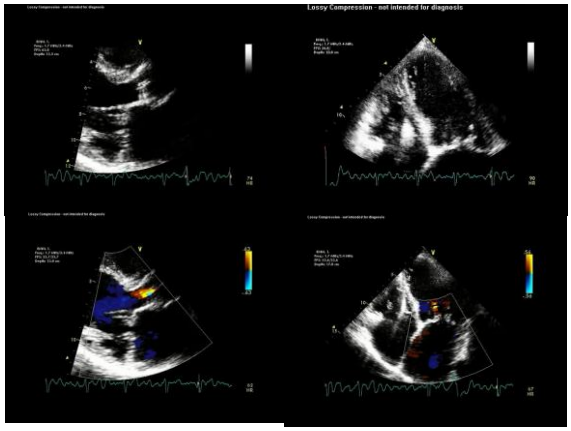
Echocardiographic Assessment for Mitral Clip in Mitral Insufficiency

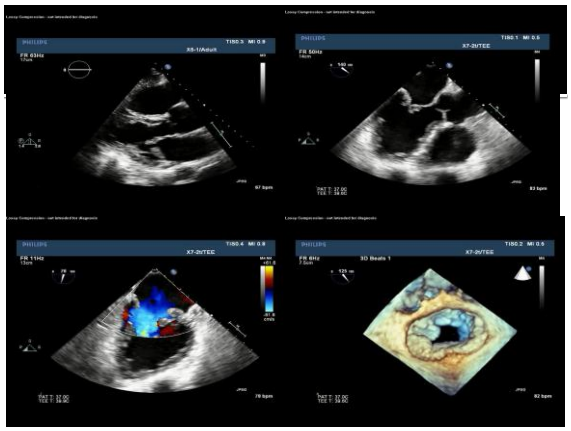
- Unacceptable anatomy
  - Jet arising in area other than A2-P2
  - Thickened or calcified leaflets
  - Flail leaflets
    - Height > 10mm
    - Width > 15 mm

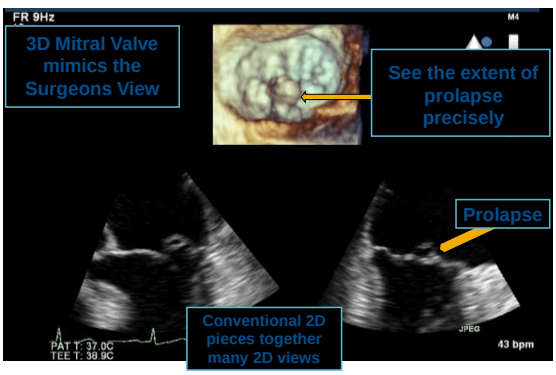


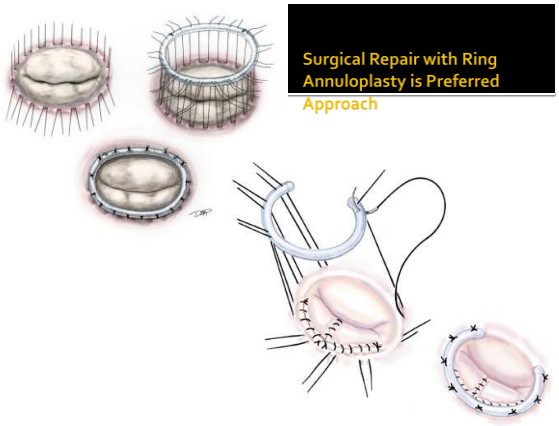
Echocardiographic Assessment for Mitral Clip in Mitral Insufficiency

- Evaluation for complications
  - Pericardial effusion
  - Clip dehiscence
  - Chordal tears
- Post implantation follow up


Lossy Compression - not intended for diagnosis

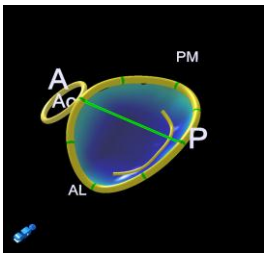


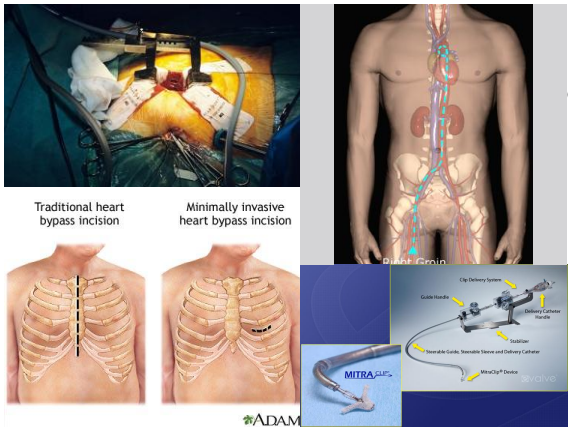

FR 9Hz
M4
3D Mitral Valve mimics the Surgeons View
See the extent of prolapse precisely
Prolapse
Conventional 2D pieces together many 2D views
PAT T: 37.0C
TEE T: 39.9C
JPEG
43 bpm



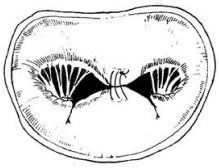
Surgical Repair with Ring Annuloplasty is Preferred Approach

Mitral Annulus Anatomy from 3D

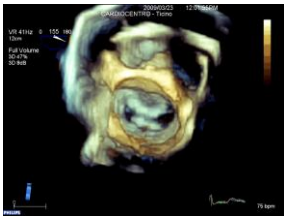




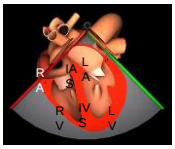
Edge-to-Edge (Alfieri) Repair



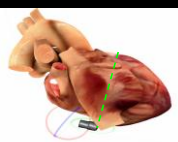
double orifice repair



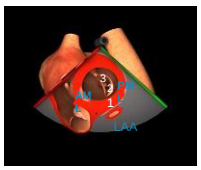
Mid esophageal 0° (4ch view, inferior)

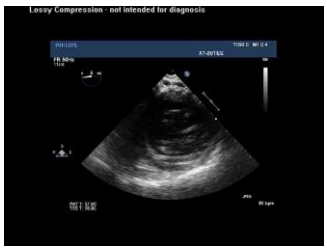


Trans-gastric short axis at MV Level



This is the ideal view for determining jet origin and arm perpendicularity.

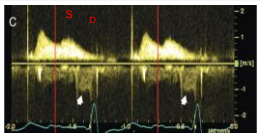




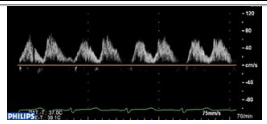
MR Assessment Parameters

- 1. Color flow- jet size
- 2. Pulmonary vein flow
- 3. Vena contracta width (cm)
- 4. Regurgitant volume (ml/beat)
- 5. Regurgitant fraction (%)
- 6. Regurgitant orifice area (PISA)

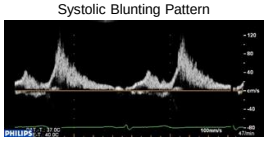
Pulmonary Vein Flow

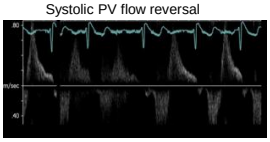


Systolic Blunting Pattern

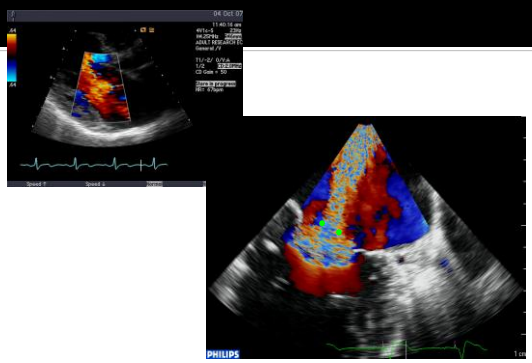


Systolic PV flow reversal

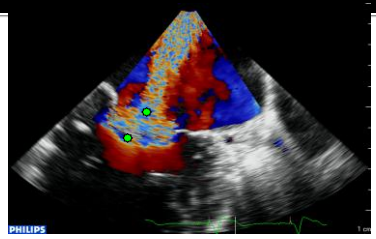




Vena Contracta

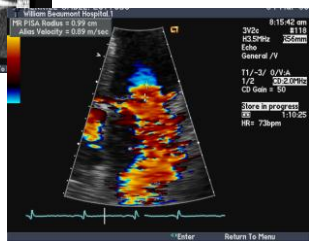


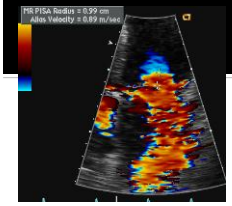
PISA

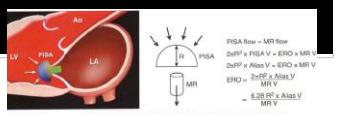


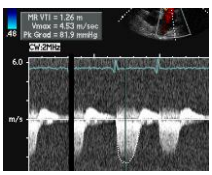
The goal of using the PISA method is to determine the size of the regurgitant orifice area (EROA)

PISA







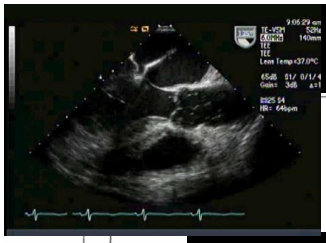


6.28 x 40 = ERO x 450 cm/s
ERO = 251 / 400
ERO = 0.56

Regurg Vol = ERO x MR TVI
RVol = 0.56 x 126 cm
RVol = 70 cc

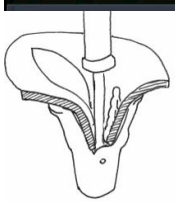
Is your patient a candidate for percutaneous repair with a Mitra-Clip?

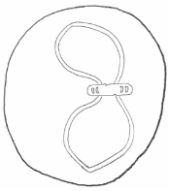
- What type of valve is a "clip-able" valve?
  - The MitraClip is designed for central jets of A2/P2 origins.
  - For functional MR; there needs to be 2mm of coaptation length or more.
  - If there is a flail gap; it must not exceed 10mm in height.
  - If there is a flail or prolapsing segment, the width must not exceed 15mm in width.
  - The Mitral Valve area must be 4cm² or greater.



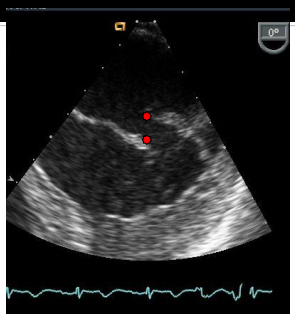
Mitra - Clip

Grasping and Leaflet insertion





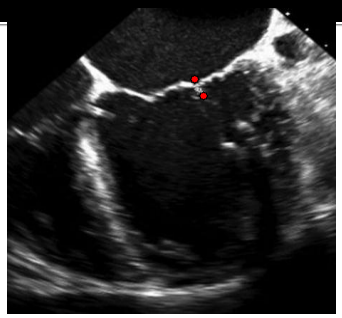
Flail Gap

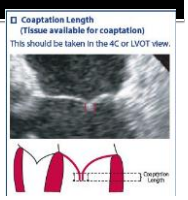


The flail gap can be measured in the 5 chamber, 4 chamber or LVOT.

Limited experience with gaps >10mm

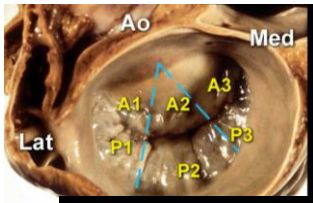
Coaptation Length

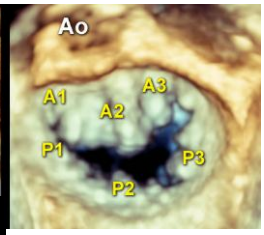


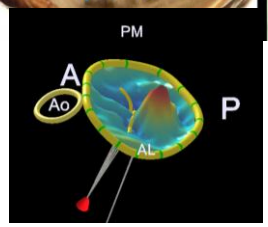


The coaptation length measurement can be taken from the 4 chamber or LVOT

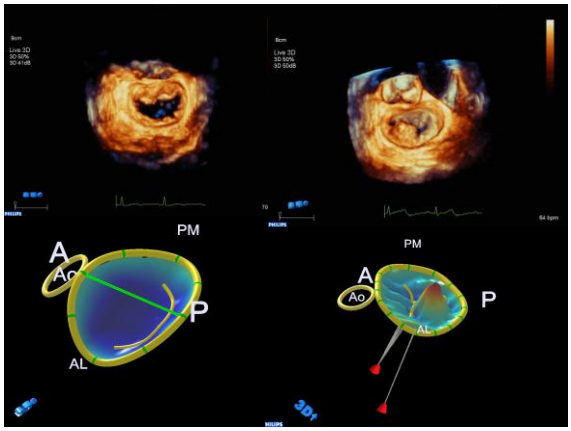
Limited experience with lengths <2mm





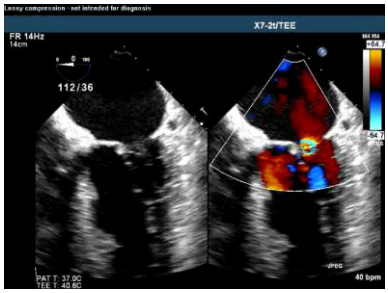


Better Definition of Valves

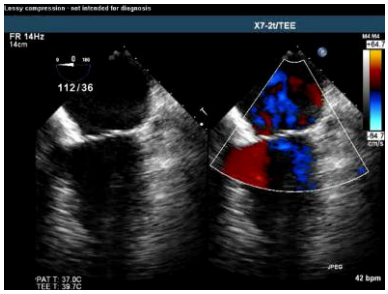


TEE Verification A1-P1

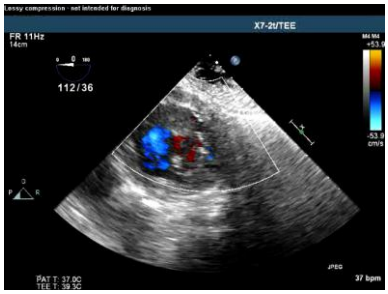
TEE Verification A2-P2



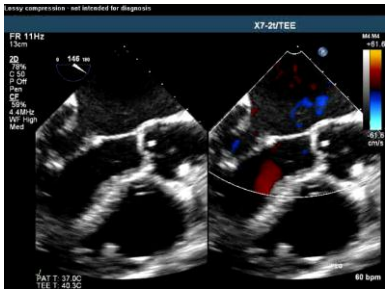
TEE Verification A3-P3



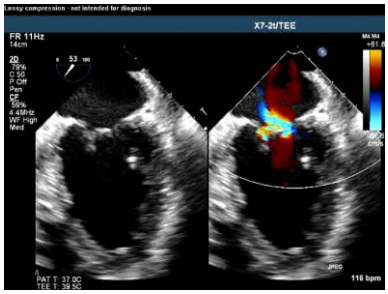
TEE Verification Transgastric



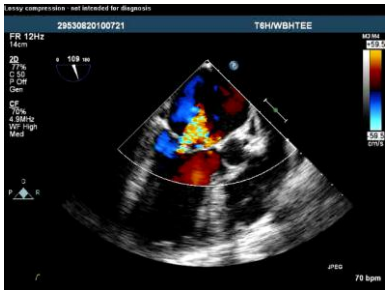
TEE Verification Long Axis



TEE Verification Commissural View



TEE Verification Suboptimal Candidate



TEE Verification Suboptimal Candidate

TEE Verification Suboptimal Candidate – 2 Year Follow Up

Mitral Clip Procedure

Procedure Steps

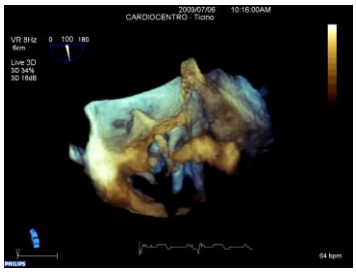
- Transeptal catheterization and left atrial positioning
- Axial alignment of the clip delivery system over the mitral orifice
- Alignment of the arms of the clip perpendicular to the line of coaptation.
- Leaflet grasping and assessment of leaflet capture
- Post–Clip placement assessment

Common Imaging Planes

- Bicaval 60°- 90°
- Short Axis at the base 40° -60°
- 4 chamber 0°
- 5 Chamber 0°
- 2 chamber 60°
- 2 chamber 90°
- LVOT 120°-150°
- Trans-gastric short 0°
  - MV Level
  - LV Level

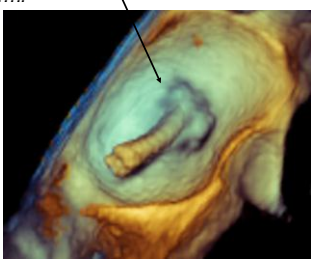
Transeptal Puncture

The site of the puncture is identified through recognition of tenting……..

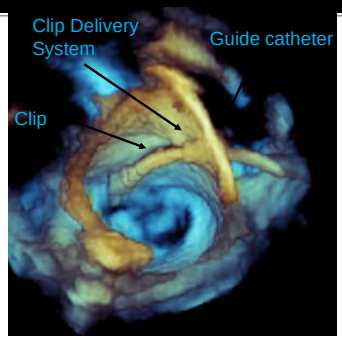


Guide Placement

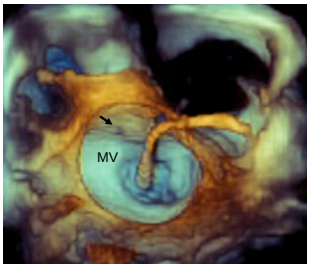
The trans-septal apparatus is exchanged for the guide catheter……..



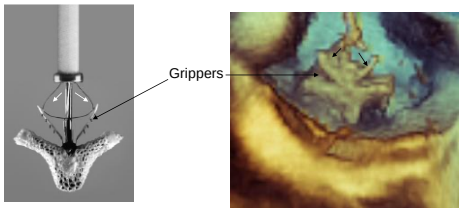
Clip Delivery System



Positioned perpendicular to the mitral valve orifice

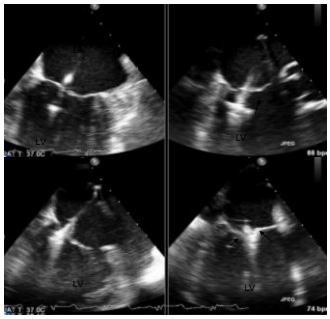


opened and closed by control mechanisms on the clip delivery system



…and centred over the regurgitant orifice

…leaflets grasping and capture are better evaluated with 2D TEE



Conclusions

- Mitral valve anatomy
- Define the morphology of the mitral valve and mechanism of mitral valve disease
- Define precise MV scallop anatomy – facilitated by 3D TEE
- Importance of non-valvular anatomy
- Patient selection for surgical vs. percutaneous repair
- Essential for pre-procedural decision making and intra-procedural guidance

Thank you

Bibliography

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- Baumgartner, H. et al. Echocardiographic Assessment of Valve Stenosis: EAE/ASE Recommendations for Clinical Practice
- **The Use of Three-Dimensional Echocardiography for the Evaluation of and Treatment of Mitral Stenosis**Cardiology Clinics - Volume 25, Issue 2 (May 2007) - Copyright © 2007 W. B. Saunders Company - About This Journal Add Journals Issue Alert
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