

Percutaneous MV Repair

Steven A. Goldstein MD FACC FASE
Professor of Medicine
Georgetown University Medical Center
MedStar Heart Institute
Washington Hospital Center
Monday, October 10, 2017

DISCLOSURE

I have **NO** relevant
financial relationships

3D-TEE in Mitral Interventions

- Surgical mitral valve repair (Operating Rm)
- **Edge-to-edge repair of mitral regurgitation**
- **Transcatheter MV insertion (TMVI)→(e.g., Tendyne)**
- **Closure of paravalvular mitral regurgitation**
- **Valve-in-valve implantation**
- **Balloon mitral valvuloplasty (mitral stenosis)**

Echo for MV Disease

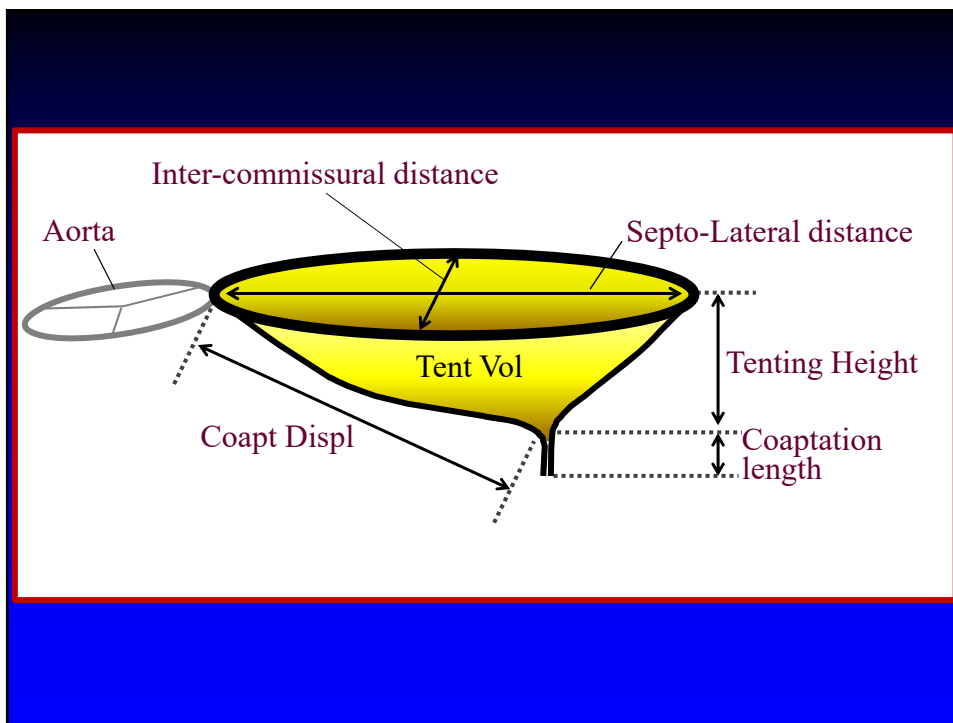
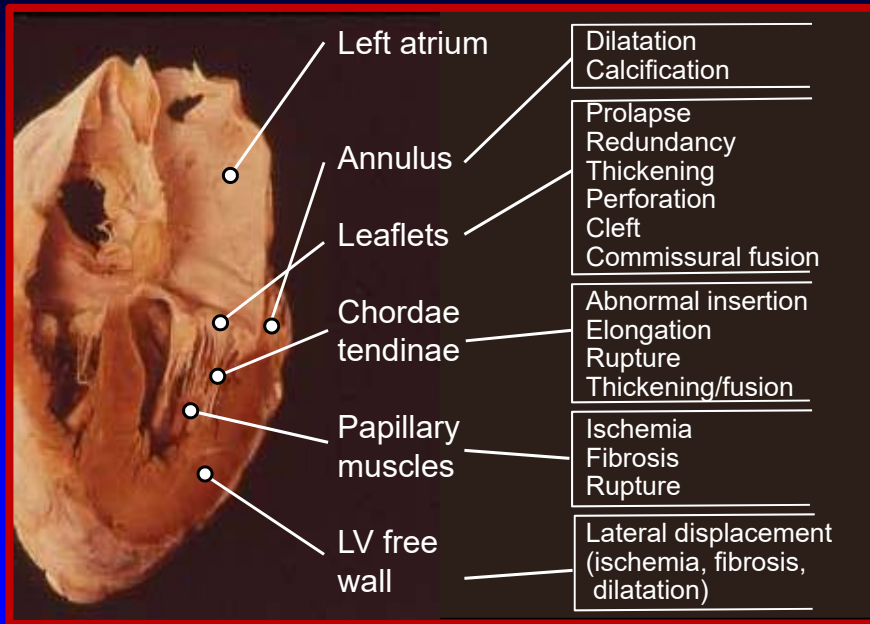
- Mitral valve anatomy/pathology
[Mechanism(s) of MV disease]
- Quantitation of MR
- Procedural guidance

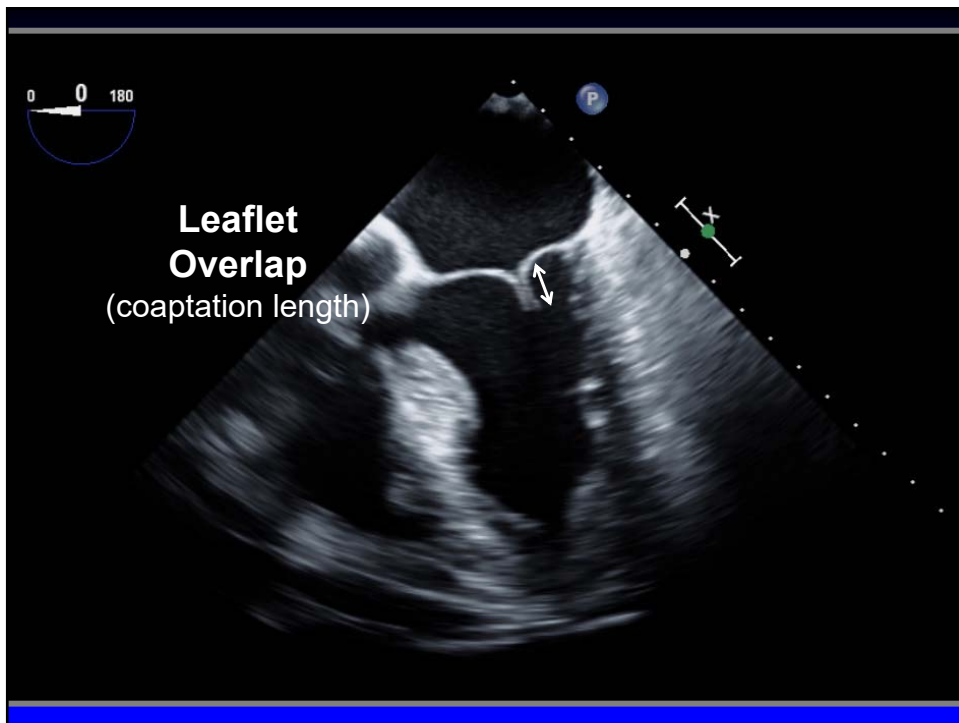
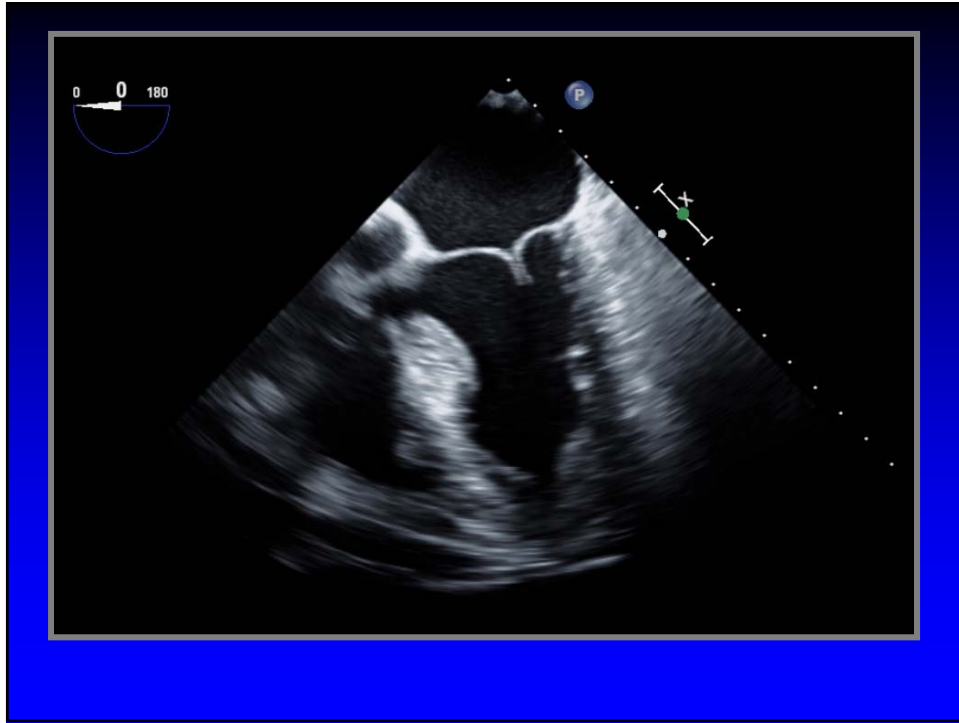
Unlike AS → singular pathology

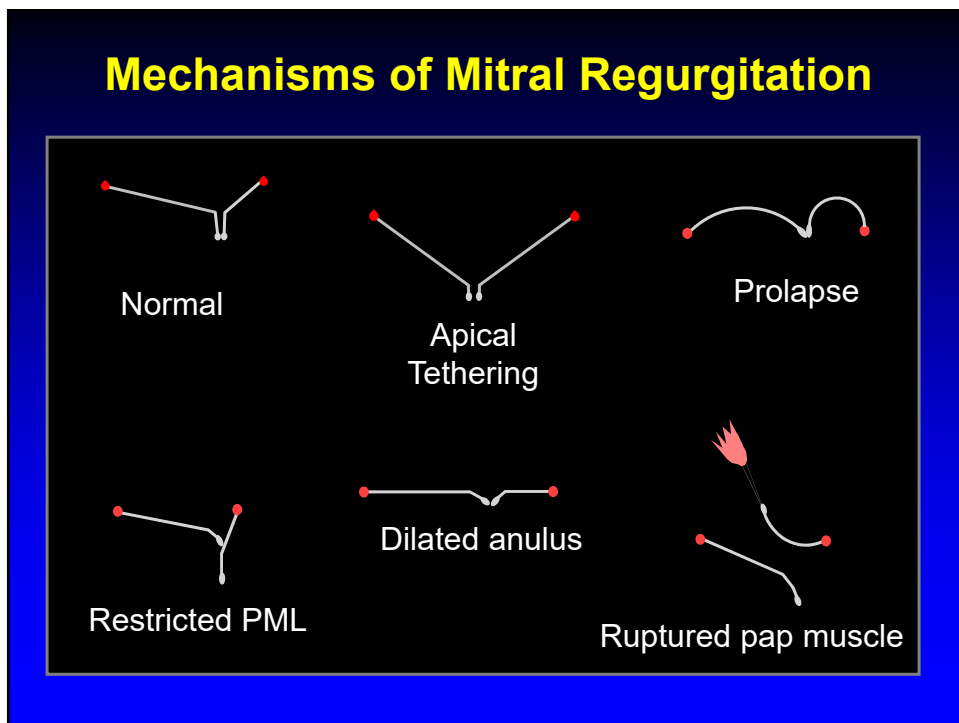
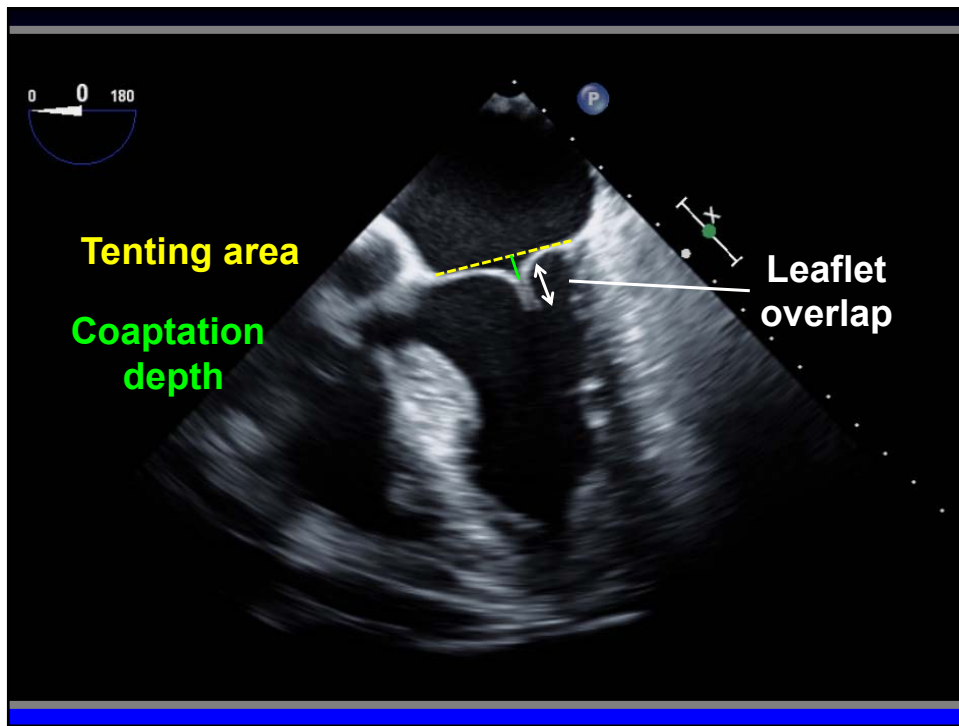
MR → highly variable etiologies

MV anatomy/pathology

Mitral Valve Apparatus







Ruptured cords

Case 1

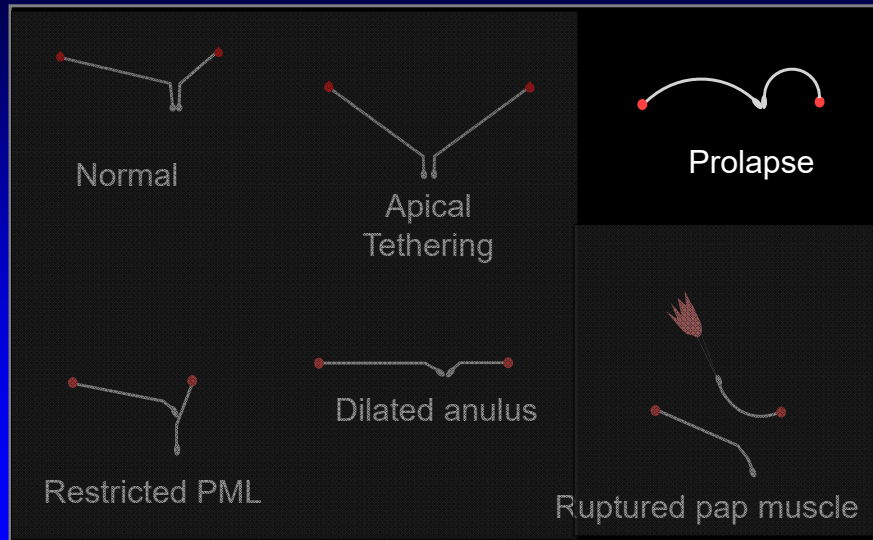
Ruptured cords P2

Case 2

Ruptured cord P2

MVP

Mechanisms of Mitral Regurgitation



Case 4

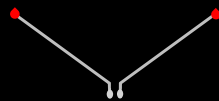
Mitral Valve Prolapse

Functional MR

Functional Mitral Regurgitation



Normal



Apical
Tethering



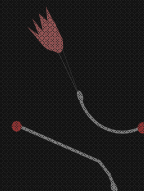
Prolapse



Restricted PML

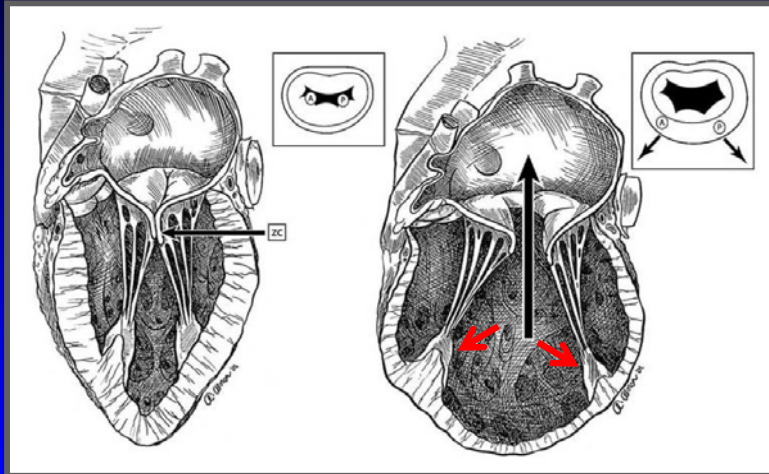


Dilated annulus



Ruptured pap muscle

Morphologic Changes in Heart Failure



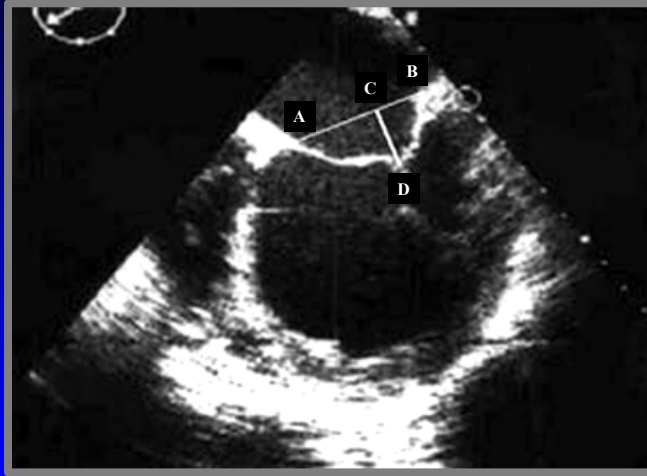
Papillary muscles displaced apically and laterally

Bolling J Heart Valve Dis 11:S28(2002)

Functional Mitral Regurgitation - Mechanisms

- Global LV dysfunction
- Regional LV dysfunction
- Increased sphericity of LV
- Excessive pap muscle displacement
- Decreased overlap of leaflets
- LA enlargement
- Loss of systolic mitral annular contraction
- Increased “tenting” area
- Delayed activation of P-M pap muscle (dyssynchrony)

Ischemic Mitral Regurgitation



Mitral leaflets are tented apically

Mitral annulus is enlarged (A-B = 45mm)

Mitral coaptation depth is increased (C-D = 13 mm)

Procedural Guidance

Essentials for Echo-Guidance

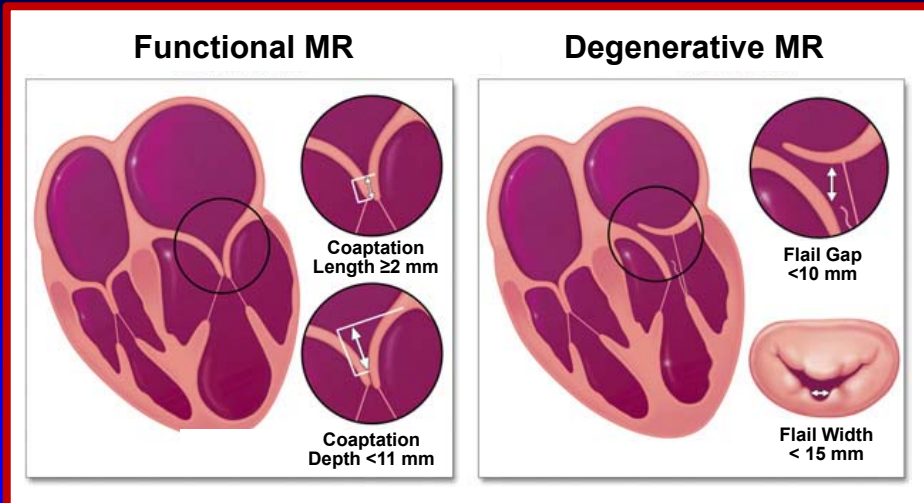
- Pre-procedure strategy b/w echocardiographer and interventionalist
- Common understanding of appropriate and necessary echo views
- Presentation of echo images on main monitor

NOTE: Fluoro limited b/c MV has no calcium

Percutaneous MV Repair Patient Selection

- Planimetered MV area $\geq 4.0 \text{ cm}^2$
- Minimal leaflet calcium in grasping area
- Width of flail segment $< 15 \text{ mm}$
- Flail gap $< 10 \text{ mm}$

Eligibility Criteria for MitraClip

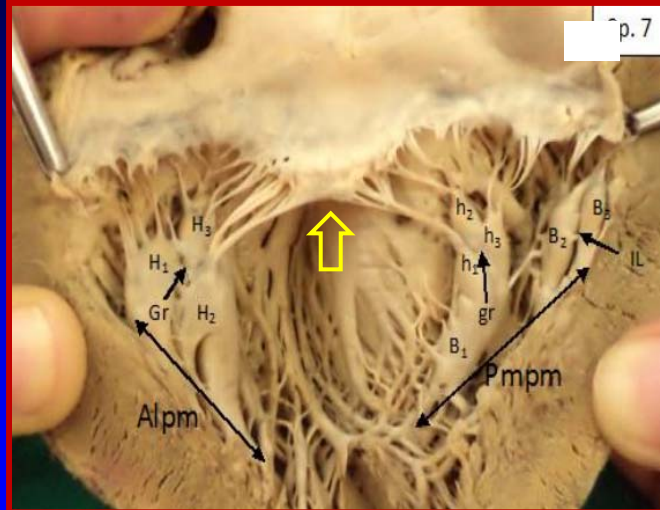


adapted from Cavalcante JACC CV Imaging 2012;5:733-746

MitraClip Procedure Ideal MV Morphology

- MR originating from mid-portion of MV (degenerative or functional etiology)
- Lack of calcification in the grasping area
- MV area > 4 cm²
- Length of posterior leaflet ≥ 10 mm
- Non-rheumatic or non-endocarditic MVD
- Flail width < 15 mm; flail gap < 10 mm
- Sufficient leaflet tissue for coaptation (coaptation depth < 11 mm; coaptation length > 2 mm)

The Mitral Valve and Subvalve Apparatus



Note lack of chordae in mid-portion of anterior leaflet

MitraClip Procedure

Less-than-Ideal MV Morphology

- Perforated MV leaflets; cleft MV leaflets
- Severe calcification in the grasping area
- Hemodynamically relevant mitral stenosis
- Length of posterior leaflet < 7 mm
- Rheumatic valve disease
- Gap between leaflets > 10 mm

Suitability for MitraClip Therapy

Classical EVEREST Criteria

- DMR
 - Location/extent of flail/prolapsing segment
 - Determine flail gap (<10 mm)
(distance from tip of flail segment to opposing leaflet)
 - Width of the flail segment (<15 mm)
- FMR
 - Coaptation depth (≤ 11 mm)
 - Coaptation length (≥ 2 mm)

Suitability for MitraClip Therapy

Unsuitable Valve Morphology

- Signif. Leaflet calcification in grasping area
- Very short posterior leaflet
- Rigidity of leaflets
- Extensive thickening of leaflets (Barlow's)
- Significant cleft
- Perforation of leaflet

Suitability for MitraClip Therapy

“Conditionally” Suitable Valve Morphology

- Pathology in segments 1 or 3 of either leaflet
- Mild calcification outside the grasping area
- MV area between 3 cm² and 4 cm²
- Flail width > 15 mm – amenable to multiple clips
- Coaptation depth ≥ 11 mm
- Mobile post. leaflet length b/w 6-7 and 10 mm

MitraClip Procedure Echo Guidance

Guidance of the Procedure

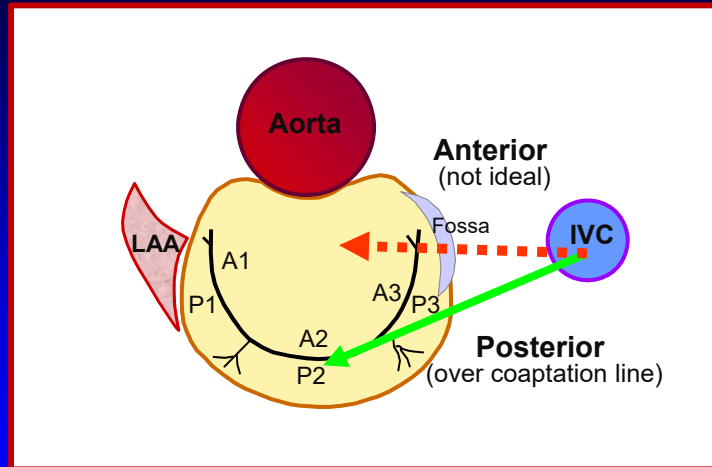
1. Transseptal puncture
2. Steerable guide catheter (SGC) insertion into LA
3. Advancement of Clip Delivery System through the SGC into the LA
4. Steering/positioning MitraClip in the LA above MV
5. Advancing MitraClip into the LV
6. Grasping the leaflets/verifying proper insertion
7. Assessment of result before clip detachment
8. Clip detachment

1. Transseptal Puncture

- Optimal puncture site important for MitraClip
- Facilitates steering maneuvers
- Minimizes complexity and duration of procedure
- Preferred site → superior-posterior portion of fossa ovalis

continued . . .

Direction of Transseptal



Standard → from IVC through center of fossa ovalis → too anterior
Preferred for MitraClip → posterior (over the coaptation line)

1. Transseptal Puncture

- Short-axis view at base ($\sim 30-50^\circ$)
(anterior-posterior orientation)
- Long-axis view (bicaval) - ($\sim 90-120^\circ$)
(superior-inferior orientation)
- Four-chamber view ($\sim 0^\circ$)
(correct height above mitral valve)

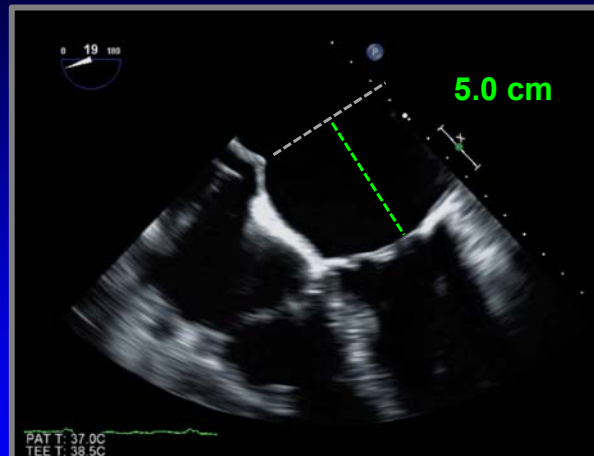
3D X-plane can present SAX and long-axis simultaneously

1. Transseptal Puncture Echo Guidance

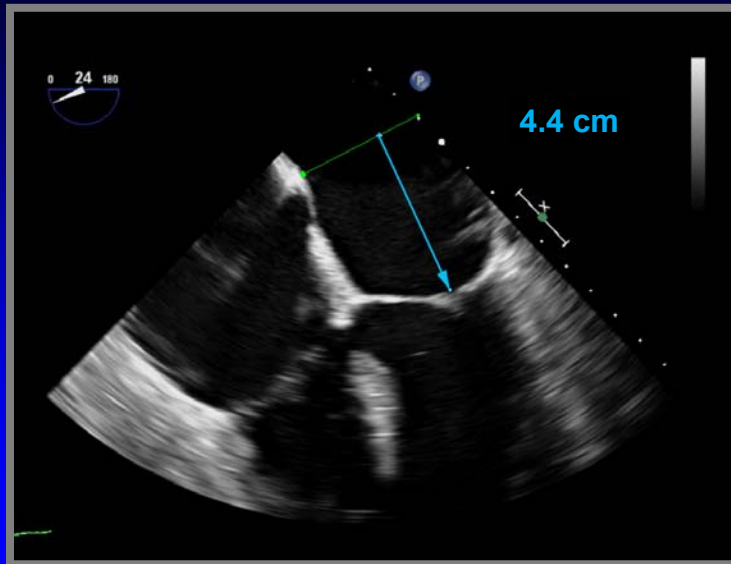
superior and posterior

- Too low → too close to MV
- High preferred → want the approach to be perpendicular to the MV

1. Transseptal Puncture



Tip of transseptal needle creates “tenting”
of the atrial septum toward LA



1. Transseptal Puncture

Optimal site above MV differs for primary (degenerative) vs secondary (functional) MR

- Primary MV disease → 4-5 cm above annulus
Provides space to maneuver the MitraClip delivery system within the LA
- Secondary MR → ~ 3.5 cm
Tenting results in a shift in position of closure line to below the mitral annulus

2. Steerable Guide Catheter (SGC) Insertion into the LA

- Exchange guidewire placed in LUPV
- SGC gently advanced over the guidewire
- Done with fluoro and TEE guidance (to avoid injury to free LA wall)
- SGC catheter has echo-bright double ring that can be seen by TEE → needs to be in LA
- SGC securely placed ~ 2-3cm within LA

3. Advancement of Clip Delivery System (CDS) through the SGC into LA

- CDS advanced thru the Steerable Guide Catheter (SGC)
- Tip of clip reaches tip of SGC (fluoro)
- CDS then further advanced into LA
- Clip should be free from LA wall and MV

4. Steering/Positioning MitraClip in the LA above the MV

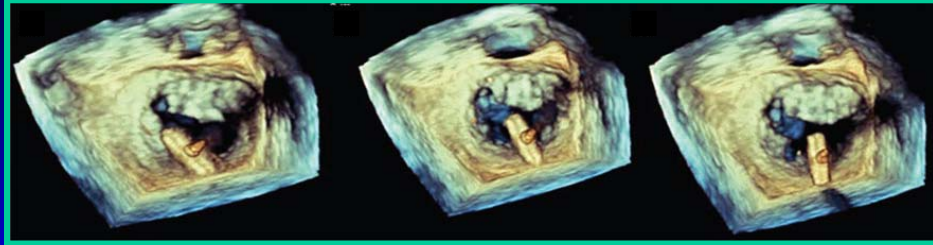
- Align clip perpendicular to mitral valve coaptation line (≈ 1 cm above valve)
- Move in small iterations
- Center over origin of MR jet (direct tip of clip towards largest PISA)
- X-Plane images: - Intercommissural view
- LVOT view
- If only 2D-TEE available \rightarrow transgastric SAX

4. Steering Clip Perpendicular to Coaptation Line - Echo Guidance

- Align clip arms perpendicular to the line of coaptation
- Maintain clip open to at 180° to help visualize the clip arms
- Advance clip into LV just below the leaflet edges prior to grasping



Steering and Positioning the MitraClip above the MV



- Align clip perpendicular to plane of mitral annulus
- Align clip arms perpendicular to coaptation line
- Align clip parallel to antegrade flow
- Move in small iterations
- Center over origin of MR jet

Wunderlich and Siegel Eur Heart J: CV Imaging 2013;;14:935-949

5. Advancing MitraClip into the LV

- System advanced across MV into LV
(\approx 2 cm below the MV)
- Usually clip is fully opened
- Reassess orientation of the clip
(Clip may rotate during “dive” into LV)
- X-plane imaging is best: - Intercommissural view
- LVOT view
- Correct positioning:
 - Perpendicular to line of MV coaptation
 - Both leaflets move freely above the clip
 - Clip splits the MR jet

6. Grasping of Leaflets

Verification of Adequate Leaflet Insertion

- Grip arms placed in grasping position ($\approx 120^\circ$)
- Pull back during systole to capture leaflets
- Verify both leaflets inserted into the clip
- Limited leaflet mobility relative to tips of clip arms
- Adequate degree of MR reduction
(if not adequate move clip or place 2nd clip)
- Creation of a double MV orifice
- Degree of MS

Midesophageal
long-axis view

6. Assessment of Leaflet Capture Echo Guidance

- Clip partially closed to secure insertion of leaflets into the clip
- Carefully assess the grasp leaflets:
 - Adequacy of leaflet insertion
 - Resultant degree of MR

Then, close the clip incrementally under echo-guidance

7. Assess Results before Clip Release

- Adequate leaflet insertion
- Degree of MR (Currently no consensus guidelines or validated studies on how to best evaluate residual MR)
- Degree of MS: - MV area $> 1.5 \text{ cm}^2$
- Mean gradient $\leq 5 \text{ mm Hg}$
- Achievement of double orifice

8. Clip Release

- Reconfirm stable clip position
- Reassess grade of residual MR
- Achievement of double orifice
- Check for pericardial effusion
- Degree of shunting through the transseptal puncture site (iatrogenic ASD)

Detection of Complications

- Pericardial effusion/tamponade
- Sudden or worsening of MR
- Partial clip detachment
- Device embolization (rare)
- Leaflet tear
- Injury to subvalve apparatus (chordal entrapment)
- Mitral stenosis
- Persistent iatrogenic ASD (seldom hemodynamically signif)
- Thrombus formation on catheters

Audiovisual → hit escape

Advance 1 slide

Back to Slide Show Mode

Case

TTE 1 day post MitraClip insertion

The End