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Assessment of Mitral Valve Prolapse by 3D TEE

Angled Views Are Key

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ASSESSMENT OF MITRAL VALVE ANATOMY by real-time 3-dimensional (3D) transesophageal echocardiography (TEE) has proven to be superior compared to 2-dimensional TEE (1,2). The standard modalities of real-time 3D TEE have recently been described (3). Demonstration of the mitral valve as seen by the surgeon (surgeon's view) with the aortic root at 12 o'clock has gained wide acceptance (Fig. 1A). However, this view may foreshorten the extent of leaflet motion and fail to give the full perspective of the severity of mitral valve prolapse and of the segments involved. Additional perspectives (angled views) reveal important details of both commissures (Figs. 1B and 1D) as well as the posterior leaflet scallops (Fig. 1C) and thereby elucidate the mechanism of mitral regurgitation. Systematic use of these views enables accurate real-time definition of involved segments in both limited (Fig. 2, Online Videos 1 and 2) and complex (Figs. 3, 4, and 5, Online Videos 3, 4, 5, 6, 7, and 8) mitral valve prolapse. It is less time consuming than off-line mitral valve reconstructions and thus more readily available for intraoperative decision making.

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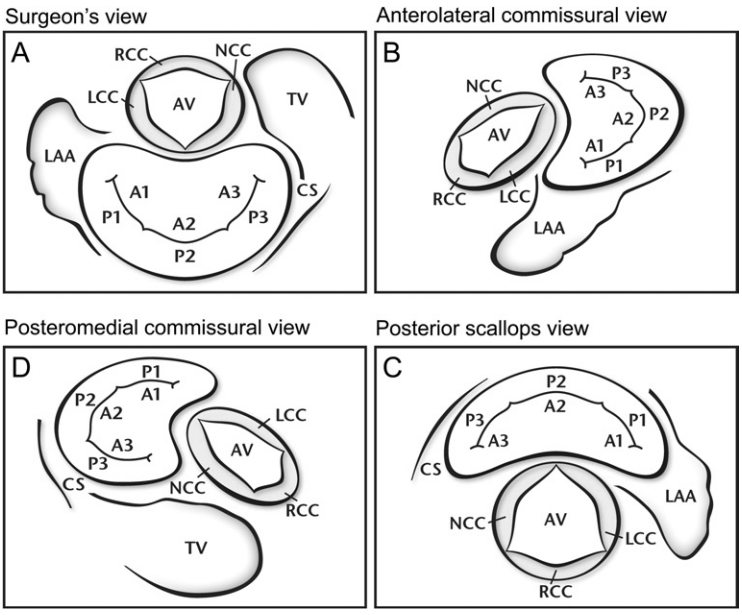

Figure 1. Overview of Our 4 End-Systolic Standard Views for Assessment of Mitral Valve Prolapse

Each view is oriented about 90° counterclockwise to the previous view. **(A)** Surgeon's view: mitral valve "en face" with the aortic valve at 12 o'clock. **(B)** Anterolateral commissural (C_{AL}) view: obtained by 90 to 110° counterclockwise rotation and 60 to 70° backward tilt of the surgeon's view. The C_{AL} view is best for evaluation of involvement of the anterolateral commissure as well as A1 and P1. **(C)** Posterior scallops (PS) view: obtained by 70 to 90° counterclockwise rotation and 20 to 30° medial tilt of the C_{AL} view. The PS view best shows the 3 scallops of the posterior leaflet. **(D)** Posteromedial commissural (C_{PM}) view: obtained by 90° counterclockwise rotation and slight forward tilt of the PS view. This view is optimal for assessment of the posteromedial commissure, P3 and A3. A1 = segment 1 of the anterior mitral valve leaflet; A2 = segment 2 of the anterior mitral valve leaflet; A3 = segment 3 of the anterior mitral valve leaflet; AV = aortic valve; CS = coronary sinus; LAA = left atrial appendage; LCC = left-coronary cusp of the aortic valve; NCC = noncoronary cusp of the aortic valve; P1= segment 1 of the posterior mitral valve leaflet; P2 = segment 2 of the posterior mitral valve leaflet; P3 = segment 3 of the posterior mitral valve leaflet; RCC = right-coronary cusp of the aortic valve; TV = tricuspid valve.

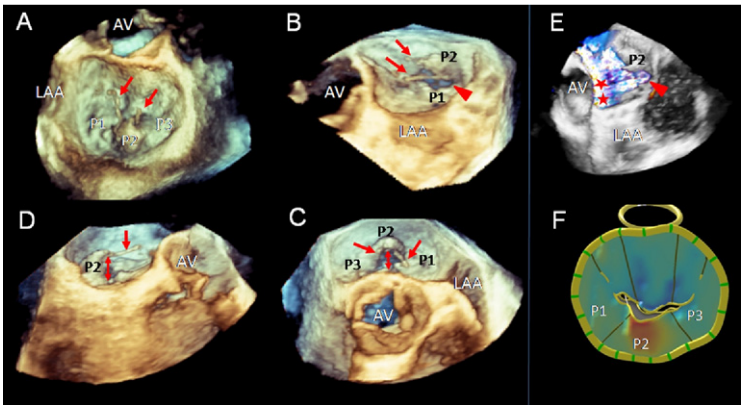

Figure 2. Isolated Flail of the P2 Segment

(A) Surgeon's view: 2 torn cords are visualized **(arrows)**, but the extent of the disease is not well appreciated (Online Video 1). **(B to D)** Angled views: these views exclude prolapse of additional scallops. **(B)** C_{AL} view: an additional "tear" **(arrowhead)** into the subcommissure between P1 and P2 is depicted. **(C)** PS view and **(D)** C_{PM} view: **double-headed arrows** demonstrate the height of the P2 flail (Online Video 2). **(E)** C_{AL} view using color-Doppler: the tear **(arrowhead)** leads to a lateral deviation of the regurgitation jet **(*)**. **(F)** Reconstructed mitral valve using Mitral Valve Quantification software (MVQ) (Advanced Quantification Software version 7.1, Philips Ultrasounds, Bothell, Washington). The details shown in **B** and **E** could not be appreciated on the otherwise accurate reconstruction. Abbreviations as in Figure 1.

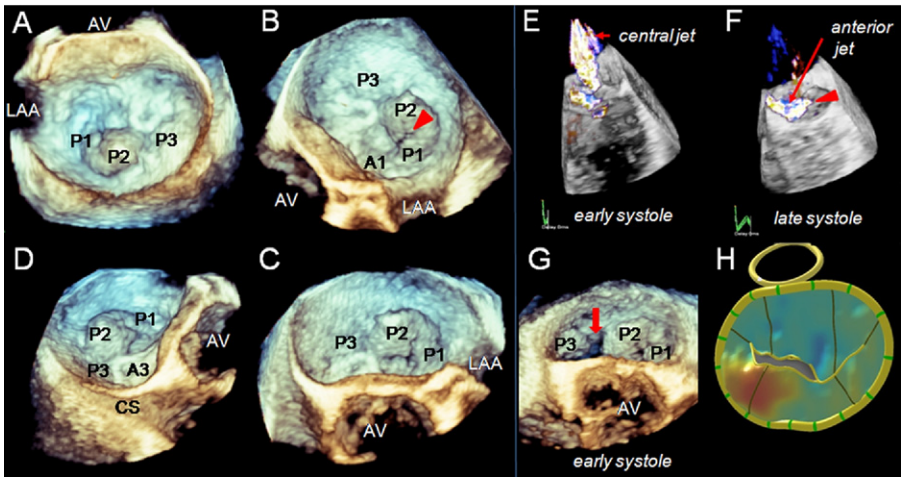

Figure 3. Complex Mitral Valve Pathology With P1 and P2 Prolapse

(A) Surgeon's view (Online Video 3): overall impression of this unusual lesion. **(B)** C_{AL} view (Online Video 4): prolapse of P1 but not of the anterolateral commissure or A1; slit-like deformed subcommissure between P1 and P2 **(arrowhead)**. **(C)** PS view and **(D)** C_{PM} view: P1/P2 prolapse without involvement of any other segment. **(E and F)** C_{AL} views using color-Doppler: in early systole **(E)** the main jet is central, arising from the P2/P3 subcommissure, whereas in late systole **(F)** the main jet is anteriorly directed, arising from the slit-like orifice of the P1/P2 prolapse **(arrowhead)**. **(G)** PS view in early systole: malcoaptation of P2/P3 subcommissure **(arrow)** causing the early systolic jet **(E)**. **(H)** MVQ (Philips Ultrasounds) image: the static reconstruction cannot represent the complex regurgitation mechanism. Abbreviations as in Figure 1.

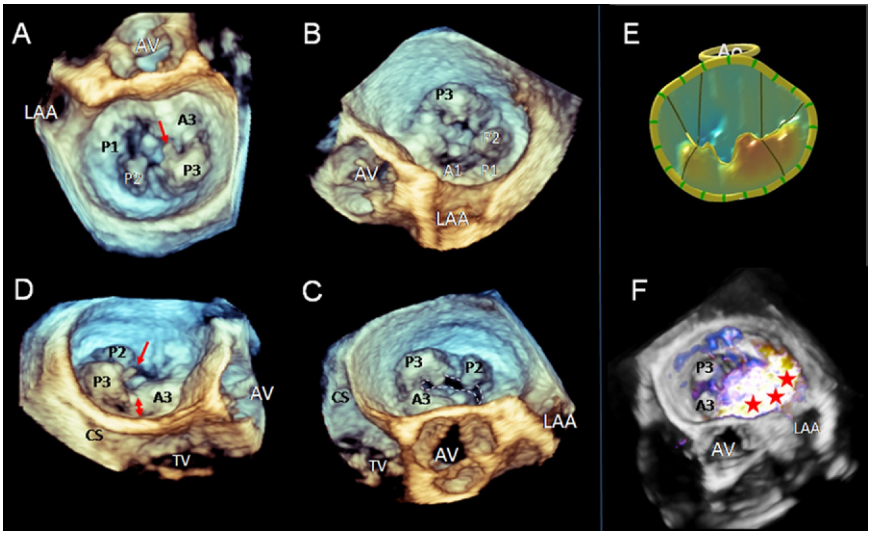

Figure 4. Complex Mitral Valve Prolapse Involving Segments P2, P3, and A3

(A) Surgeon's view (Online Video 5): P2 and P3 prolapse and a small P3 flail **(arrow)** can be appreciated. **(B)** C_{AL} view: no involvement of A1 and P1 but an impressive P3 prolapse. **(C)** PS view: clear definition of involved segments; estimation of the large anatomical regurgitant orifice area (AROA) **(dashed white line)**. **(D)** C_{PM} view (Online Video 6): involvement of the posteromedial commissure **(double-headed arrow)** as well as A3. **(E)** MVQ (Philips Ultrasounds) image: underestimation of the mitral valve pathology as described above. **(F)** PS view using color-Doppler: the large AROA leads to severe and very eccentric regurgitation **(*)**. Abbreviations as in Figure 1.

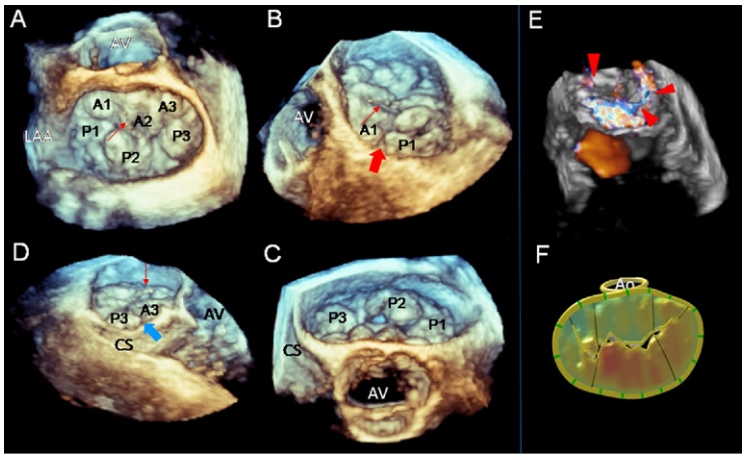

Figure 5. Barlow-Type Mitral Valve With Prolapse of All Segments

(A) Surgeon's view (Online Video 7): grossly deformed mitral valve with a ruptured chord attached to P2 **(red thin arrow)**. **(B)** C_{AL} view: involvement of A1, P1, and the anterolateral commissure **(red thick arrow)**. **(C)** PS view (Online Video 8): impressive myxomatous deformation of all scallops. **(D)** C_{PM} view: prolapse of A3, P3, and the posteromedial commissure **(blue thick arrow)**. **(E)** C_{AL} view with color-Doppler: multiple jets with different directions **(red arrowheads)**. **(F)** MVQ (Philips Ultrasounds) image: reconstruction in surgeon's view shows extensive posterior leaflet prolapse but does not demonstrate commissural involvement or extent of anterior leaflet disease. Abbreviations as in Figure 1.

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