CHAPTER 14  ANNULAR SIZE VARIATION

In Appendix C we described the methods used to derive the best-fit planes to the annular and anterior leaflet markers. In this chapter, we visualize the valve along the Z-axis for the six hearts H1-H6, looking from the left atrium toward the left ventricle, clamping the best-fit annular plane to the X-Y axis. All scales are in mm.

Figures 14.1A and 14.1B show two time-samples during the cardiac cycle, the left panel at minimum annular area (during systole), the right panel at maximum LV inflow (during diastole) with the mitral annulus clamped to the X-Y axis. In these figures, the red symbols with black borders show annular marker positions with a cubic spline (thick black curved line) connecting these markers to delineate the mitral annular border. The larger black symbols show anterior leaflet edge marker positions, with lines connecting these markers to delineate the anterior leaflet border. Smaller black symbols show marker positions on the marker belly. A green line, drawn from lateral annular marker #18 to posterior leaflet edge marker #37 indicates the position of the central meridian of the posterior leaflet P2 scallop. Thin black lines, representing chordal connections, radiate from the anterior papillary tip (Marker #31, on the left) to the anterior edge and belly of the anterior leaflet and from the posterior papillary tip (Marker #33, on the right) to the posterior edge and belly of the anterior leaflet. A heavy black line is drawn from the septal annular marker (#22) at the top of each figure downward to the left ventricular apex (Marker #1, not shown). Anterior leaflet color coding maps the Z-coordinate of leaflet regions as being above or below (mm) the best-fit annular plane that is clamped to the X-Y axis. Color coding in the left (minimum annular area) panels is dark red (+3 to +4mm); red (+1mm); yellow (-1mm); green (-2mm); turquoise (-3mm); blue (-5mm); and dark blue (-6 to -9mm). Color coding in the right (maximum inflow) panels is dark red (+3 to +4mm); red (-1mm); yellow (-4mm); green (-6mm); turquoise (-10mm); blue (-14mm); and dark blue (-15 to -20mm).

At no time during the cardiac cycle does the edge or belly of the anterior leaflet bulge above the annular plane. The only portion of the anterior leaflet above this annular plane is the “drumhead” hinge region supported rather tightly by the rigid trigone collagen skeleton.

Note that the mitral annulus exhibits a large variation in size during the cardiac cycle and these dimensional changes occur rather uniformly throughout the entire contractile (non-trigonal) portion of the annulus. Note also that during maximum inflow (right panels) the anterior leaflet does not open completely, but presents a surface to partially deflect left ventricular inflow away from the outflow tract.

Figure 8.2 in Chapter 08 visualizes the gap that must be filled by the posterior leaflet scallops from the mitral annulus to the anterior leaflet edge in the closed valve.
Figure 14.1A Mitral annulus and anterior leaflet at minimum annular area (left panels) and maximum inflow (right panels) for hearts H1-H3 as viewed from the left atrium toward the left ventricle (along the Z-axis) with the best-fit annular plane clamped to the X-Y plane. See text for further description.
Figure 14.1B Mitral annulus and anterior leaflet at minimum annular area (left panels) and maximum inflow (right panels) for hearts H4-H6 as viewed from the left atrium toward the left ventricle (along the Z-axis) with the best-fit annular plane clamped to the X-Y plane. See text for further description.