CHAPTER 24 POSTERIOR LEAFLET OPEN

Figure 24.1 repeats, for reference purposes, the marker locations shown and described in Chapter 23.

We begin by examining the maximum extent of posterior leaflet opening relative to the mitral annulus. To view this, in each sample frame we performed a translation to place Marker #22 at the origin, perform 2 rotations to place Marker #18 on the x-axis, then performed a final rotation to place anterior commissure Marker #16 into the x-y plane. This placed the mitral annulus into the x-y plane (to very close approximation) at each sample time. We then view the resulting mitral valve geometry along the z-axis, looking from the left atrium toward the left ventricle. Appendix E provides frame-by-frame animations showing the geometry of the mitral valve as described by three-dimensional cubic splines passing through connected marker locations during a representative beat (from maximum LVP in one beat to maximum LVP in the following beat) for the hearts studied in this fashion.

Figures 24.2, 24.3, and 24.4 show three views of the mitral complex during the frame in the animation exhibiting maximum posterior leaflet opening (greatest posterior leaflet perimeter) for hearts COM07R04, COM02R02, and COM06R01. In each figure, the lower left panel plots left ventricular pressure (LVP, mmHg) in blue, the distance between anterior and posterior leaflet edge markers (D78,
mm) in green, the annular perimeter (AP, mm) in red, and the posterior leaflet perimeter (LP, mm) in teal. Perimeters were assessed in each frame by summing the distances in 3-space between adjacent markers for that frame. An open circle is placed at the time-frame (in Figure 24.2, Frame 35) when the geometric data in the other three panels are visualized. These three panels illustrate mitral valve geometry in three orthographic views: the upper right panel viewing the valve from the left atrium to the left ventricle, the upper left panel from the posterior commissure toward the anterior commissure, and the lower right panel from the septum toward the lateral mitral annulus. The red dot in each of these panels is the saddlehorn Marker #22, the black dot is the lateral mitral annular Marker #18, and the green dot is the anterior commissure Marker #16. The dashed lines represent the strut chords from the anterior papillary tip (Marker #26) to its insertion into the anterior leaflet (Marker #29) and from the posterior papillary tip (Marker #23) to its insertion into the anterior leaflet (Marker #30). The red spline shows the anterior leaflet edge (connecting Markers #1-4-7-10-13), the blue spline shows the posterior leaflet edge (connecting Markers #1-2-3-5-6-8-9-11-12-14-13) and the black spline shows the mitral annulus (connecting Markers #22-15-16-17-18-19-20-21-22).

**Figure 24.3** Three dimensional view of the mitral complex during maximum posterior leaflet opening for a representative beat in heart COM06R01. See detailed description in text.
Note that:
1. The maximum posterior leaflet opening silhouette is virtually identical to the annular silhouette (upper right panel in each figure). Thus, flow from the left atrium into the left ventricle would not be expected to encounter significant restriction associated with a narrowed opening due to the posterior leaflet.
2. The strut chordae hold the basal half of the anterior leaflet out of the left ventricular outflow tract (upper right panel in each figure), so this portion of the anterior leaflet will slightly impede LV inflow.
3. Anterior leaflet opening takes place primarily at the leaflet edge (upper left panel in each figure).
4. The posterior leaflet perimeter varies to a much greater extent throughout the cardiac cycle than the annular perimeter (lower left panel in each figure). The posterior leaflet perimeter in these hearts ranged from 51 to 90 mm during the cardiac cycle with a mean change of 32 mm; the mitral annular perimeter ranged from 88 to 114 mm, with a mean change of 13 mm; and the anterior leaflet perimeter (shown in the next chapter) ranged from 27 to 38 mm with a mean change of only 7 mm.
5. It is almost impossible to assess the geometry of the leaflet edges from any single view, even if that view is derived from 3-D data. Several simultaneous views are required to understand the very complex geometry of these leaflets in three-dimensional space.