

C97. Assessing Human Mitral Valve Stress Using Three-dimensional Echocardiography And Finite Element Analysis

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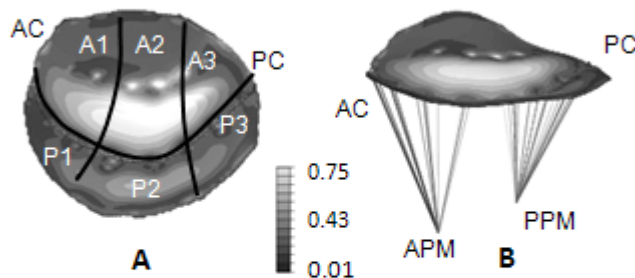
OBJECTIVES: The realization that many mitral valve repair failures are stress related has stimulated interest in developing clinically applicable quantitative leaflet stress evaluation techniques. We hypothesize that Finite Element Analysis (FEA) in conjunction with real-time three-dimensional echocardiography (rt-3DE) can quantify leaflets stress in normal, pathological and repaired mitral valves.

METHODS: Transthoracic rt-3DE using an IE33 platform (Philips) was performed in 10 normal human subjects. Full-volume data sets of each mitral valve (MV) at end systole were obtained and exported to Tomtec Cardio-View software for image analysis. Leaflet data were interpolated, reconstructed, and meshed using custom Matlab algorithms. To facilitate the presentation of quantitative stress, a hybrid MV was constructed from all subjects (n = 10). Papillary muscle head locations and triangulated leaflet surfaces of the hybrid valve were imported into a FEA program (ABAQUS/Explicit 6.3) to quantify regional stress distributions under transvalvular pressure loading. Von Mises (VM) values were then averaged by leaflet region (A1-A3; P1-P3).

RESULTS: The results are presented as the mean \pm stdev in the table. The contour plot of the predicted VM stresses in transvalvular (A) and oblique (B) views are presented in the figure. Maximal stress within both leaflets occurred in their mid sections (A2 and P2) with the peak overall valve stress occurring at A2.

CONCLUSIONS: Rt-3DE can provide quantitative models of the functioning human MV. These models can be loaded with physiologic pressures using FEA to predict leaflet stresses. Similar analyses may be applicable in guiding operative planning and assessing repair durability.

Regional Mitral Valve Von Mises Stress (Mpa)



Stress (MPa)	A1	A2	A3	P1	P2	P3
Mean	0.16	0.22	0.14	0.08	0.12	0.09
STDEV	0.07	0.11	0.08	0.04	0.06	0.04