# Physically-coherent Extraction of Mitral Valve Chordae

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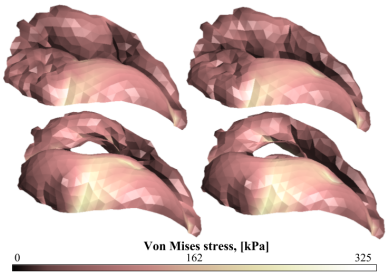
**Introduction:** Surgical repair of mitral valves is challenging as it is difficult to anticipate the outcome of any modification of the valve structure, particularly the tendinous chords. Recent works on computer-based models of mitral valve behavior have been obtained on one dataset, where extraction of the complex valve structure is manual and tedious. On the contrary, we propose a method to segment the chords with little human supervision. We prove the effectiveness of our algorithm by comparing our segmentation to the manual delineation by the simulation of the valve closure.

**Methods:** Our segmentation method is based on the topological properties of the structures to differentiate chordae and non-chordae components. In order to show that the structure is physically coherent, we performed a finite element method (FEM) based biomechanical simulations of the valve closure under peak systole. We have tested our simulation with chordae being segmented manually and automatically under different configurations: all the chordae and partial chordae present, which corresponds to the valve malfunctioning case.




Simulation results with von Mises stress distribution: manual (right) and automatic (left) segmentation with all (up) and partly absent chordae (down).

**Results and conclusion:** The results show that the simulations with manual and automatic chordae extraction lead to similar final valve configurations. With the whole chordae set the valve stays sealed. In the case of chordae absence, leaks and bulging appear. The bulging - i.e. the volume above the valve annulus plane - increases by 2.5 and 2.1 times for the manual and automatic segmentation, respectively. The von Mises stress distribution for both cases is as well comparable: the error in mean value between manual and automatic methods is 3.3% (all chordae) and 4.2% (partly absent chordae). We conclude that our work could help the community in extracting patient-based mitral valve 3D models with proof that the model is physically coherent.