Hypertrophic Obstructive Cardiomyopathy (HOCM) is a common complication of Hypertrophic Cardiomyopathy effecting up to one of 200 people of the general population. HOCM is characterized by obstructive motion of the anterior mitral leaflet causing mitral regurgitation, compromising systolic left ventricular (LV) reduced ejection fraction, and significant outflow pressure gradients (>30mmHg). Some patients who are unresponsive to medication are prone to highly invasive surgery, including myectomy or ablation, with relatively high mortality and morbidity rates.

We propose an improvement of both the flow regimes and pressure gradients by placing a percutaneous device in the LV using a minimally invasive procedure, making current invasive surgery treatment redundant.

Utilizing computational fluid dynamics (CFD) methods, we developed an innovative and unique process to mimic the LV displacements giving us the tools to analyze hemodynamics and predict blood hemodynamics in healthy, pathological and treated LV cases. The results are used to compare the effects of a percutaneous device on the position of the mitral valve leaflets and the hemodynamics of the different LV cases.

Models include transient time-dependent FSI analyses of the flow in 3D models of the healthy LV, the pathologic HOCM LV and the treated LV. In addition, a contact analysis of the structural model of LV myocardium is used to construct the LV geometry after device implantation in the HOMC LV.

Analyses show that the disturbed flow patterns and high pressure gradients over the aortic root found in the pathological case were reduced dramatically using the device. These analyses will prove the implantation concept feasibility and will be used as background to further research.