

# Left Ventricular Shape, Myocardial and Intracavitary Volume Alteration After Surgical Ventricular Restoration: Effect on Left Ventricular Contractility

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**Background.** Left ventricular (LV) surgical ventricular restoration (SVR) is believed to confer additional benefits (favorable LV geometry) in patients undergoing coronary artery bypass grafting (CABG). We compared LV shape and contractility changes in patients undergoing CABG with versus without SVR.

**Methods.** 10 subjects with coronary disease and impaired LV ejection fraction (EF) <35% underwent cardiac magnetic resonance on a 1.5T MR scanner (Siemens, Avanto) less than 2 weeks before and 4 months after CABG (group 1, n=7) or CABG+SVR (group 2, n=3). We measured LV volume (V) at all time instants by analyzing trueFISP short-axis MR images using standard methodology. We calculated the following indices:

1. LVEF;
2. Shape factor S, the ratio of LV minor and major axes;
3. V\*, ratio of end-diastolic myocardial volume and intracavitary volume;
4.  $\sigma^*$ , pressure-normalized LV wall stress, which has been formulated by our group previously as a complex function of S and V\* (Zhong et al. J Biomech 2006;39:2397-2409), where.

$$\sigma^* = \frac{\sigma}{P} = \frac{(2+S)}{V^*} \left[ 1 - \frac{S^2(2+S)}{2(2+S)+V^*} \right]$$

5. A novel contractility index,  $|d\sigma^*/dt|_{\max}$ , the maximal absolute time derivative of  $\sigma^*$ .

**Results.** The preoperative and 4-month postoperative dS/dt, dV\*/dt and  $d\sigma^*/dt$  at all time instants during ejection in one CABG+SVR patient are shown in the figure. Compared to group 1, group 2 had greater mean S (or more spherical LV geometry), LV volume reduction, LVEF and contractility (based on  $|d\sigma^*/dt|_{\max}$ ). These differences were not statistically significant, likely due to small patient numbers (table).

**Conclusion.** SVR does not appear to improve LV shape. Complex interaction of the rates of change of shape (dS/dt) and LV myocardial-intracavitary volume ratio (dV\*/dt), not LV shape, determine LV contractile performance.

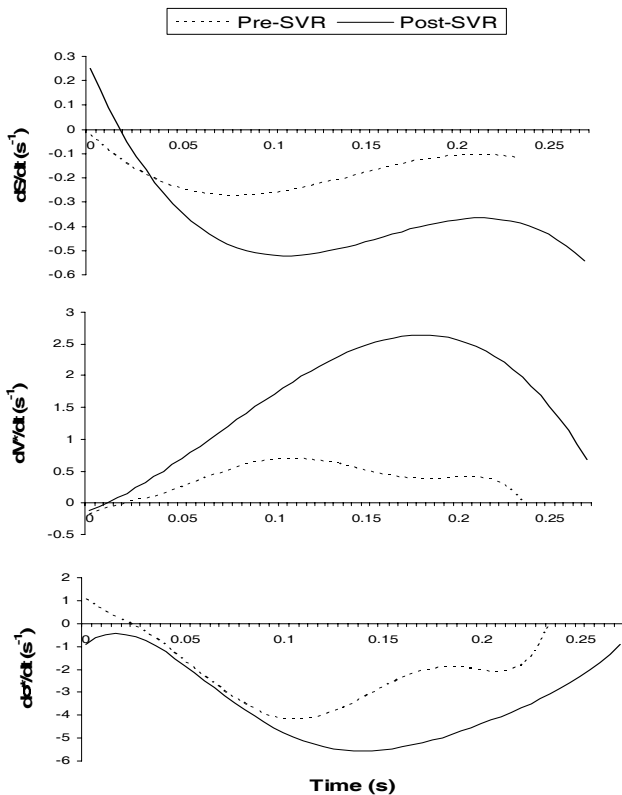


Figure. Preoperative and 4-month postoperative dS/dt, dV\*/dt and  $d\sigma^*/dt$  at all time instants during ejection in one CABG+SVR patient

Parameter	Group 1- CABG			Group 2 – CABG+SVR			p value
	Pre-op	Post-op	% change	Pre-op	Post-op	% change	
LVEDVi (ml/m <sup>2</sup> )	166.1±33.4	156.7±39.2	-5.6	128.1±19.6	94.3±14.1	-26.3	0.1129
LVESVi (ml/m <sup>2</sup> )	136.6±33.4	121.9±36.8	-10.8	100.3±26.4	61.3±7.4	-38.9	0.0591
LVEF (%)	18.3±4.3	23.2±6.0	+26.6	22.6±9.3	34.6±7.9	+52.8	0.2360
S	0.48±0.08	0.48±0.08	+0.68	0.48±0.05	0.55±0.04	+13.4	0.0663
V*	0.51±0.17	0.58±0.19	+13.8	0.55±0.09	0.61±0.18	+11.6	0.8810
dS/dt (s <sup>-1</sup> )	0.24±0.06	0.28±0.08	+15.0	0.37±0.15	0.61±0.12	+65.2	0.0573
dV*/dt (s <sup>-1</sup> )	0.79±0.36	1.12±0.74	+41.6	1.04±0.46	1.83±0.69	+76.0	0.1816
$ d\sigma^*/dt _{\max}$ (s <sup>-1</sup> )	4.66±1.48	4.99±1.09	+6.9	5.99±1.69	7.27±1.51	+21.4	0.2719

Table. MR-derived left ventricular functional parameters before and after CABG (n=7) versus CABG+SVR (n=3)