Surgical ventricular restoration fails to improve regional left ventricular shape in terms of curvedness

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Introduction: The surgical ventricular restoration (SVR) by Dor procedure consists of surgically creating a smaller ventricle with a more normal shape via an endoventricular circuloplasty technique used to treat ventricular aneurysms. The effect of this surgery on left ventricle (LV) shape has not been fully studied. We have recently published a new method for determining LV shape in terms of curvedness based on three-dimensional (3D) LV models from magnetic resonance imaging (MRI) [1-2]. Patients with ischemic dilated cardiomyopathy had significantly smaller LV regional curvedness (in particular at the apex region) compared to normal hearts.
Purposes: To examine regional LV shape before and after SVR in a clinical population.
Methods: We performed a retrospective analysis of prospectively consecutively acquired MRI data of 40 patients with ischemic cardiomyopathy (mean age, 69±9 years, 36 males), who had undergone coronary artery bypass graft (CABG) combined with SVR. The SVR procedure was performed by means of endoventricular circular patch plasty by Dor procedure. The MRI acquisition was performed both before and after surgery. Short-axis and long-axis MRI were used to reconstruct end-diastolic (ED) and end-systolic (ES) LV three-dimensional geometry. The principal maximum and minimum curvatures on the endocardial surface were determined by using our custom software and the local surface curvedness (C) was calculated as the root mean square of these principal curvatures. The C values were averaged in infarct zone (IZ), border zone (BZ) and remote zone (RZ) and compared between groups of zones using one-way ANOVA. Student's paired t-test was used to assess any significant differences before and after SVR.
Results: After SVR, there was decreased LV end-diastolic volume index (pre SVR=156±39 ml/m^2, post SVR=110±33 ml/m^2 $p<0.0001$) and end-systolic volume index (pre SVR=117±39% ml/m^2, post SVR=77±31 ml/m^2, $p<0.0001$) and an improved ejection fraction (pre SVR=26±7%, post SVR=31±10%, $p<0.0001$). However, there was no significant improvement on curvedness at end-diastole, C_{ED}, and end-systole, C_{ES}, in all zones after SVR, except C_{ED} at border zone. (see table).
Conclusion: Surgical ventricular restoration decreases left ventricular end-diastolic and end-systolic volumes but fails to improve regional left ventricular shape. This remaining distorted shape after surgery may contribute to worsening heart failure in the long-term.

Table: Curvedness at end-diastole (C_{ED}) and end-systole (C_{ES}) pre- and post SVR

	Pre-SVR				*Post-SVR*			
	RZ	BZ	IZ	ANOVA p value	RZ	BZ	IZ	ANOVA p value
C_{ED} (mm^{-1})	0.030±0.006	0.032±0.005	0.036±0.006	0.0001	0.032±0.005	0.038±0.01*	0.039±0.010	0.0001
C_{ES} (mm^{-1})	0.035±0.006	0.037±0.006	0.039±0.007	0.053	0.038±0.008	0.039±0.01	0.040±0.011	0.55

*P<0.05 for 2-tail paired t-test used in comparing pre- and post-SVR values; RZ, remote zone; BZ, border zone; IZ, infarct zone

References:
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2. Zhong L, et al: *Am J Physiol Heart Circ Physiol* 2009;296:H573-H584.