Assessment of Mitral Valve Repair With Exercise Echocardiography: Artificial Chordae vs Leaflet Resection

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Mitral valve (MV) repair with artificial chordae (AC) or leaflet resection (LR) is associated with good hemodynamics at rest. The aim of this study was to compare these techniques in terms of exercise capacity and echocardiographic parameters of hemodynamics at rest and peak exercise. We conducted a study in 2015 of 56 patients, who had undergone surgery for degenerative posterior mitral leaflet prolapse between 2005 and 2014 using either AC (n = 24) or LR (n = 32). Clinical data were collected, exercise capacity was measured, and resting echocardiography and peak exercise echocardiography were performed. No significant differences were detected among groups regarding exercise duration or peak exercise workload measured in Watts (W) (AC: 136 ± 43 W and LR: 131 ± 40 W; P = 0.65). The mean mitral gradient at rest was 3.0 ± 1.3 mm Hg in the AC group and 3.0 ± 1.0 mm Hg in the LR group (P = 0.90). The mean MV gradients at peak exercise did not differ significantly between groups (AC: 8.3 ± 3.4 and LR: 11.3 ± 8.7; P = 0.19). Four patients (17%) in the AC group and 1 (3%) in the LR group had systolic anterior motion, P = 0.15. We conclude that both methods of posterior MV leaflet repair were associated with good hemodynamics at rest and peak exercise. The groups had comparable exercise capacity. MV pressure gradients at rest and peak exercise were similar in both groups.

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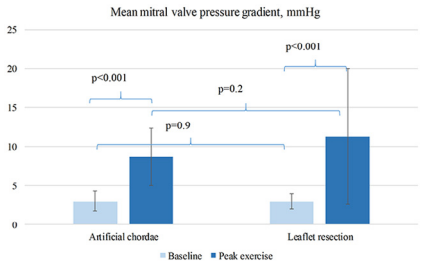
Keywords: mitral valve repair, exercise echocardiography, artificial chordae, mitral valve gradient



Mean mitral valve pressure gradients at rest and during peak exercise.

Central Message

Both methods of posterior leaflet mitral valve repair were associated with good hemodynamics at rest and peak exercise.

Perspective Statement

Posterior mitral leaflet repair is usually done with either leaflet resection or by using artificial chordae. Both techniques result in similar resting hemodynamics. Little is known about hemodynamics of the different surgical methods during exercise. We performed exercise echocardiography on operated patients showing good hemodynamics and low mitral valve gradients during exercise in both groups.

INTRODUCTION

Mitral valve (MV) repair for severe mitral insufficiency (MI) owing to degenerative disease has been shown to be associated with excellent long-term results with a low reoperation rate.[1,2] The most common methods of repair are leaflet resection (LR) of the prolapsing segment with either a quadrangular or a triangular resection or use of artificial chordae (AC). In current clinical practice, preservation of the posterior leaflet using AC has permitted repair of complex degenerative mitral lesions and now is a widely adopted technique.[3,4] The rationale for this approach follows several principles of reconstructive MV surgery: provide the largest possible orifice area, maximize the leaflet coaptation area, preserve ventriculoannular continuity, and minimize leaflet tension.[5] MV repair with AC has been studied using resting echocardiography and shown to produce hemodynamics and mitral orifice area similar to LR. However, little is known about long-term hemodynamic outcomes measured during peak exercise of the different surgical methods for MV repair. The aim of this prospective, nonrandomized, observational cohort study was to determine how preservation of leaflet structure using AC compares with the widely adopted technique of LR in terms of long-term hemodynamic outcomes evaluated by exercise capacity and with echocardiography at rest and during peak exercise.

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MATERIAL AND METHODS

Patient Population and Definitions

Between January 2005 and January 2014, 154 patients underwent primary repair for isolated posterior mitral leaflet (PML) prolapse owing to degenerative disease (Fig.). This etiology of severe MI is the form of MV disease that is most frequently repaired, and during this period, we replaced LR, the standard method of posterior leaflet repair, with AC. Two patients had both AC and LR and were not included. Thus of the remaining 152 patients, 79 underwent LR and 73 AC repair using extended polytetrafluoroethylene sutures (Gore-Tex, WL Gore & Associates, Flagstaff, AZ). Freedom from reoperation at 1 year for these 152 patients was 100% in both groups. At 5 years, freedom from reoperation was 96.5% ± 2.5% in the AC group vs 100% in the resection group, log rank $P = 0.24$.

The following exclusion criteria for this study were applied (Fig): (1) patients living outside of Skane county, (2) age > 80 years, (3) deceased during follow-up, (4) the need of a translator, (5) chronic atrial fibrillation, (6) combined repair using LR and AC, (7) severe annular calcification according to the operative report, (8) use of a rigid annuloplasty ring, (9) robotic-assisted surgery, (10) left ventricular (LV) ejection fraction of <45% after surgery based on the most recent echocardiography, (11) severe aortic stenosis or severe aortic regurgitation based on the most recent echocardiography, (12) recurrent moderate or severe MI, and (13) reoperation owing to recurrent MI. Overall, 75 patients met the inclusion criteria; of these, 43 had undergone repair with resection techniques and 32 had undergone repair with AC. A letter of invitation to participate was sent, and the patients were later contacted by telephone. Consequently, 59 patients consented to participate; of these, 33 had undergone LR and 26 had undergone repair with AC. One patient (AC) was not able to participate owing to illness; 1 patient (LR) was not able to exercise owing to rheumatic arthritis; and 1 patient exercised but was excluded from analysis because of digital storage failure. The remaining 56 patients had a cumulative mean follow-up from surgery to the exercise of 5.5 ± 3.2 years (median = 4.5 years, interquartile range [IQR]: 2.8-8.0).

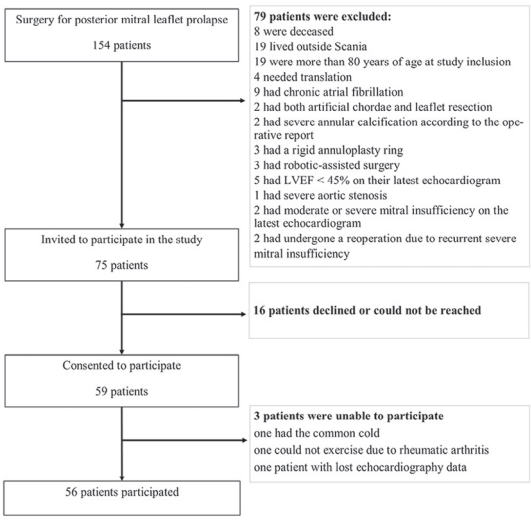

Figure. Study outline.

Primary Endpoint

We postulated that compared to repair with LR, PML repair with AC is associated with a lower MV pressure gradient at rest and during peak exercise.

Secondary Endpoints

As secondary endpoints, we postulated that PML repair with AC is associated with (1) a lower pulmonary artery pressure at rest; (2) better physical performance in terms of exercise duration and maximum exercise capacity, lower incidence of residual MI, and lower pulmonary artery pressure during physical exercise; and (3) better LV function and remodeling at rest.

Finally, we evaluated whether PML repair with AC was associated with fewer readmissions owing to adverse cardiac events.

Study Protocol

The study protocol was approved by the Regional Ethical Review Board in Lund, Sweden (2014/784). Before exercise echocardiography, previous and current medical history was assessed and a physical examination was performed. All postoperative medical conditions requiring rehospitalization, current medications, and the current New York Heart Association class were recorded. Previous postoperative echocardiograms were reviewed for comparison. Functional capacity was assessed using the Duke activity status index.[6] A 12-lead electrocardiogram (ECG) was reviewed, focusing on the presence of arrhythmias and signs of myocardial ischemia. The presence of sinus rhythm was confirmed.

Echocardiography Examination

Transthoracic echocardiography was conducted with the Vivid 7, General Electric ultrasound system (Boston, MA) with ECG trigger that recorded at least 3 loops and stored for subsequent offline analysis. All measurements were performed with standard 2-dimensional and Doppler echocardiographic images acquired in the left lateral decubitus position using a phased-array transducer in the parasternal and apical views by a single-experienced investigator blinded for clinical data. LV end-diastolic and end-systolic dimensions were measured from parasternal acquisitions. LV volumes and ejection fraction were calculated using the modified Simpson biplane method. LV stroke volume was measured by