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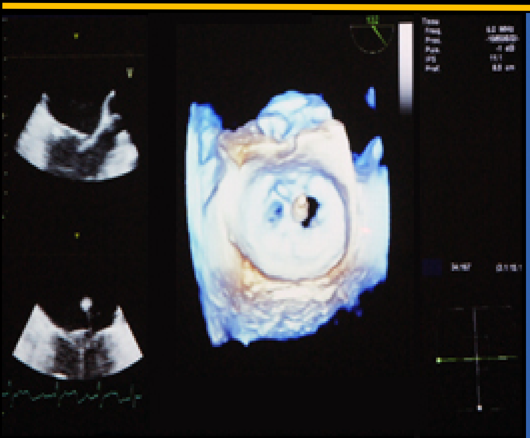
Controversy in secondary mitral valve regurgitation: Repair

Khalil Fattouch, MD, PhD.



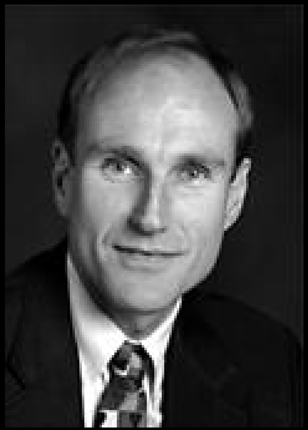
EuroValve
March 27-28 2015
Radisson BLU Hotel, Nice, FRANCE

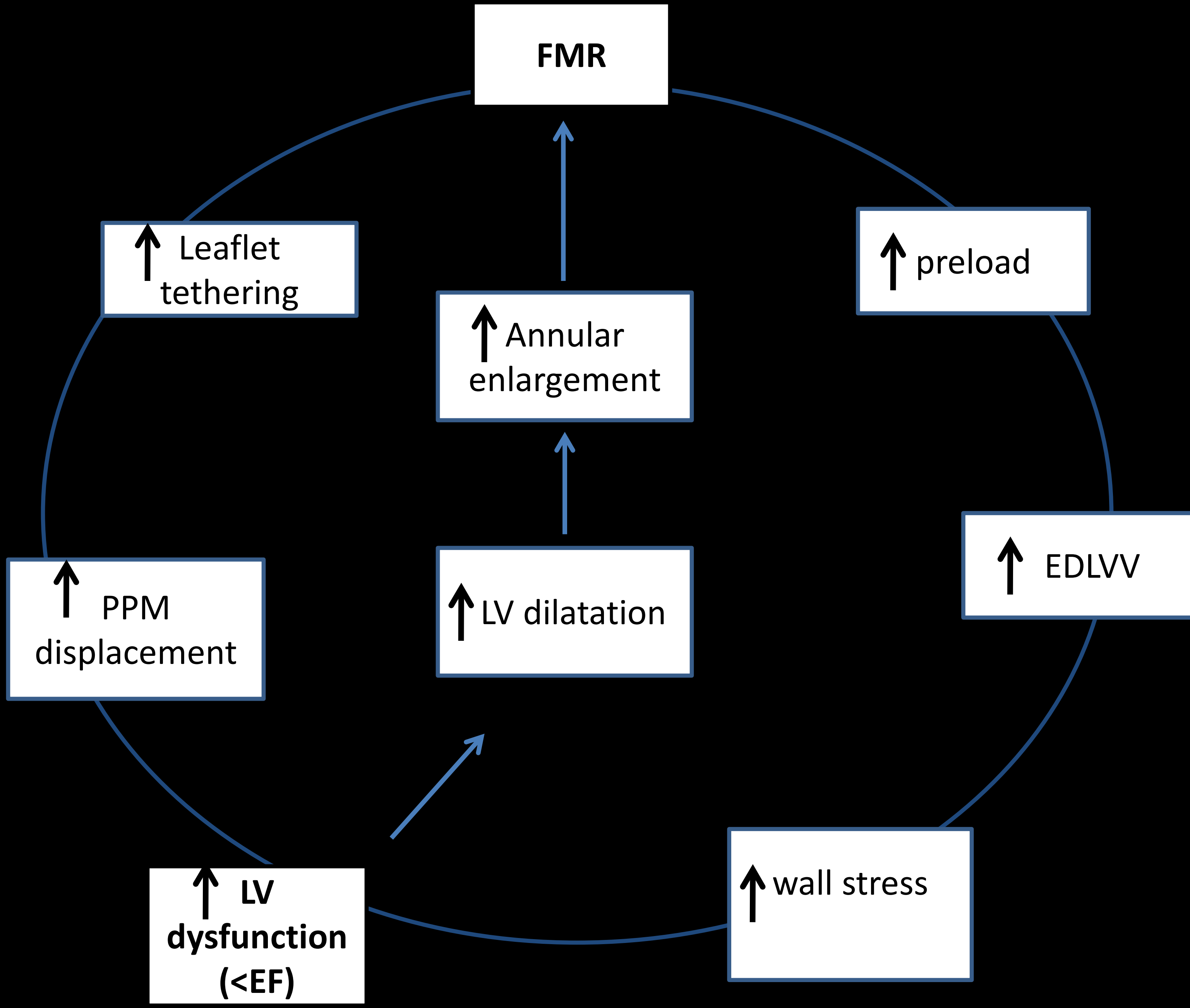
Background

- Secondary MR remains one of the most complex and unresolved aspect in the management of heart valve disease
- MR occurs approximately in 20%-25% of patients followed up after MI

FUNCTIONAL MR IS NOT A VALVULAR DISEASE,
IT IS A VENTRICULAR DISEASE.

Steven F. Bolling, MD




FMR
↑ preload
↑ EDLVV
↑ wall stress
↑ LV dysfunction (<EF)
↑ PPM displacement
↑ Leaflet tethering
↑ Annular enlargement
↑ LV dilatation

Effect of IMR on Left Ventricular Remodelling

Levine wrote,

MR, caused by altered geometry and function after acute MI, can itself initiate remodelling. MR alters LV loading; it increases diastolic wall stress, which can induce LV dilation and failure, and end systolic wall stress, with decreased contractility and increased end-systolic volume.

Because of this vicious circle, MR begets more MR.

Levine et al. Circulation 2005; 112:745-58.

Guidelines on the management of valvular heart disease (version 2012)

The Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Table 13 **Indications for mitral valve surgery in chronic secondary mitral regurgitation**

	Class[a]	Level[b]
Surgery is indicated in patients with severe MR[c] undergoing CABG, and LVEF >30%.	I	C
Surgery should be considered in patients with moderate MR undergoing CABG.[d]	IIa	C
Surgery should be considered in symptomatic patients with severe MR, LVEF <30%, option for revascularization, and evidence of viability.	IIa	C
Surgery may be considered in patients with severe MR, LVEF >30%, who remain symptomatic despite optimal medical management (including CRT if indicated) and have low comorbidity, when revascularization is not indicated.	IIb	C

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Rick A. Nishimura, Catherine M. Otto, Robert O. Bonow, Blase A. Carabello, John P. Erwin III, Robert A. Guyton, Patrick T. O'Gara, Carlos E. Ruiz, Nikolaos J. Skubas, Paul Sorajja, Thoralf M. Sundt III and James D. Thomas

Circulation. published online March 3, 2014;

Class IIa

1. **Mitral valve surgery is reasonable for patients with chronic severe secondary MR (stages C and D) who are undergoing CABG or AVR.** ***(Level of Evidence: C)***

Class IIb

1. **Mitral valve repair or replacement may be considered for severely symptomatic patients (NYHA class III to IV) with chronic severe secondary MR (stage D) who have persistent symptoms despite optimal GDMT for HF (224-235).** ***(Level of Evidence: B)***
2. **Mitral valve repair may be considered for patients with chronic moderate secondary MR (stage B) who are undergoing other cardiac surgery.** ***(Level of Evidence: C)***

Mitral Repair versus Replacement for Ischemic Mitral Regurgitation

Comparison of Short-Term and Long-Term Survival

Julien Magne, PhD; Nicolas Girerd, MD; Mario Sénéchal, MD; Patrick Mathieu, MD; François Dagenais, MD; Jean G. Dumesnil, MD; Éric Charbonneau, MD; Pierre Voisine, MD; Philippe Pibarot, DVM, PhD, FAHA

Table 1. Preoperative Demographic, Clinical, and Echocardiographic Data

Variables	All Patients (n=370)	MV Repair (n=186; 50%)	MV Replacement (n=184; 50%)	*P*	*P**
Demographic data					
Age, yr	66±9	66±9	66±10	NS	NS
Male, n (%)	238 (64)	128 (69)	110 (60)	NS	NS
Body mass index, kg/m²	27±5	27±5	27±5	NS	NS
Clinical data					NS
Hypertension, n (%)	200 (54)	107 (58)	93 (51)	NS	NS
Diabetes, n (%)	114 (31)	61 (33)	53 (29)	NS	NS
Chronic lung disease, n (%)	72 (19)	31 (17)	41 (22)	NS	NS
Renal failure, n (%)	80 (22)	28 (15)	52 (28)	0.002	NS
Atrial fibrillation, n (%)	94 (25)	48 (26)	46 (25)	NS	NS
Pulmonary hypertension, n (%)	108 (29)	42 (23)	66 (36)	0.005	NS
Stroke, n (%)	24 (6)	8 (4)	16 (9)	NS	NS
Chronic heart failure, n (%)	144 (39)	58 (31)	86 (47)	0.0026	NS
NYHA functional class≥III, n (%)	246 (66)	106 (57)	140 (76)	0.0002	NS
Parsonnet score	24.8±11	23±10	26.5±11	0.0023	NS
Echocardiographic data					
Severe mitral regurgitation, n (%)	342 (92)	163 (88)	179 (97)	0.005	NS
LV end-diastolic diameter, mm	57±7	58±7	56±6	0.015	NS
LV end-systolic diameter, mm	42±9	42±8	43±10	NS	NS
LV ejection fraction, %	43±15	45±15	40±14	0.0006	NS

NYHA indicates New York Heart Association.
**P* after adjustment for propensity score.

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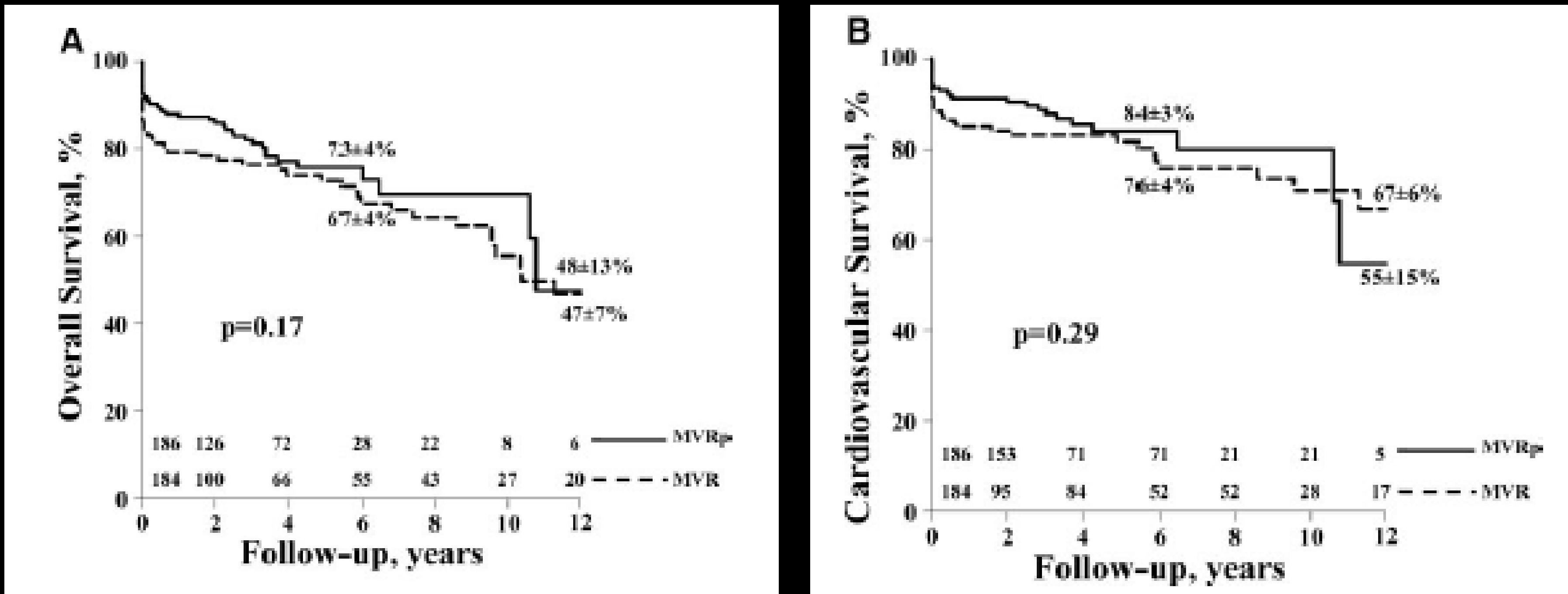
Table 3. Univariate and Multivariate Predictors of Operative Mortality

	Univariate		Multivariate Model		Propensity Score-Adjusted Multivariate Model	
Variables	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)
Preoperative						
Age, per yr	<0.0001	1.08 (1.04–1.1)	0.001	1.07 (1.03–1.1)	0.001	1.07 (1.03–1.1)
Male	0.025	2 (1.1–3.6)	0.29	1.4 (0.7–2.8)	0.81	1.1 (0.5–2.2)
Body mass index, per kg/m^2	0.73	1.01 (0.9–1.1)	...	...	...	...
Hypertension	0.77	1.1 (0.6–2)	...	...	...	...
Diabetes	0.84	1.07 (0.56–2)	...	...	...	...
Chronic lung disease	0.21	1.6 (0.8–3.1)	...	...	...	...
Renal failure	0.003	2.6 (1.4–4.9)	0.10	1.8 (0.9–3.7)	0.28	1.5 (0.7–3.5)
Atrial fibrillation	0.92	1.04 (0.5–2)	...	...	...	...
Pulmonary hypertension	0.26	1.4 (0.8–2.7)	...	...	...	...
Stroke	0.28	1.8 (0.6–4.9)	...	...	...	...
Recent heart failure	<0.0001	4.2 (2.2–8)	0.004	3.7 (1.5–9)	0.009	3.4 (1.3–8.5)
NYHA functional class≥III	0.011	2.8 (1.3–6.2)	0.64	1.4 (0.4–3.8)	0.69	0.8 (0.2–2.5)
LV ejection fraction, per %	0.77	1 (0.9–1.02)	...	...	...	...
Severe mitral regurgitation	0.31	1.5 (0.7–3.3)	...	...	...	...
Operative						
MVRp versus MVR	0.03	2 (1.06–3.6)	0.21	1.5 (0.8–3.1)	0.34	1.5 (0.7–2.9)
Propensity score	0.0001	2.4 (1.5–3.8)	...	...	0.38	1.3 (0.7–2.6)

Operative Mortality

Overall operative mortality was 13.5% (n=50) in the whole cohort, which is similar to the mortality rates reported by previous studies in similar high-risk populations.[10–13] Operative mortality was significantly (P=0.03) lower in patients who underwent MVRp (9.7%) than in those with MVR (17.4%). Multivariate analysis revealed that independent predictors of operative mortality (Table 3) were age (OR, 1.07; P=0.001) and recent episode of heart failure (OR, 3.7; P=0.004). In this multivariate analysis, MVRp provided no significant benefit over MVR (OR, 1.5; 95% CI, 0.8–3.1; P=0.21). When further adjusting for propensity score in multivariate analysis, age and recent heart failure remained significantly associated with increased mortality risk, whereas the type of surgical procedure was still not significantly associated with this end point (Table 3).



A
Overall Survival, %
100
80
60
40
20
0
73±4%
67±4%
48±13%
47±7%
p=0.17
186 126 72 28 22 8 6
MVRp
184 100 66 55 43 27 20
MVR
0 2 4 6 8 10 12
Follow-up, years
B
Cardiovascular Survival, %
100
80
60
40
20
0
84±3%
76±4%
67±6%
55±15%
p=0.29
186 153 71 71 21 21 5
MVRp
184 95 84 52 52 28 17
MVR
0 2 4 6 8 10 12
Follow-up, years

Table 4. Univariate and Multivariate Predictors of Overall Mortality

	Univariate		Multivariate Model		Propensity Score-Adjusted Multivariate Model	
Variables	*P*	HR (95% CI)	*P*	HR (95% CI)	*P*	HR (95% CI)
Preoperative						
Age, yr	<0.001	1.05 (1.02–1.1)	0.001	1.05 (1.02–1.1)	<0.001	1.05 (1.02–1.1)
Male	0.051	1.5 (0.9–2.2)	0.04	1.6 (1.03–2.6)	0.04	1.6 (1.01–2.6)
Body mass index, kg/m^2	0.75	1.01 (0.9–1.1)	...	...	...	...
Hypertension	0.74	1.5 (0.9–2.2)	...	...	...	...
Diabetes	0.20	1.3 (0.9–2)	...	...	...	...
Chronic lung disease	0.06	1.6 (0.9–2.5)	0.64	1.1 (0.7–1.8)	0.73	1.1 (0.6–2)
Renal failure	<0.001	2.3 (1.5–3.4)	0.08	1.5 (0.9–2.5)	0.61	1.2 (0.6–2.1)
Atrial fibrillation	0.16	1.4 (0.9–2.1)	...	...	...	...
Pulmonary hypertension	0.07	1.5 (0.9–2.2)	0.06	1.6 (0.9–2.5)	0.45	1.2 (0.7–2.2)
Stroke	0.14	1.6 (0.8–3.1)	...	...	...	...
Recent heart failure	<0.001	2.5 (1.6–3.8)	0.02	1.9 (1.1–3.3)	0.19	1.5 (0.8–3)
NYHA functional class≥III	0.005	2.2 (1.3–3.9)	0.58	1.2 (0.6–2.5)	0.90	1.05 (0.5–2.2)
LV ejection fraction, per %	0.015	0.98 (0.97–0.99)	<0.001	0.97 (0.91–0.98)	0.001	0.95 (0.91–0.98)
Severe mitral regurgitation	0.76	1.1 (0.5–2.6)	...	...	...	...
Operative						
MVRp versus MVR	0.17	1.3 (0.9–2)	0.27	1.3 (0.8–2.1)	0.52	1.2 (0.7–1.9)
Propensity score	0.008	1.5 (1.1–2)	...	...	0.17	1.8 (0.8–4.1)

Conclusion—As opposed to what has been reported in patients with organic MR, the results of this study suggest that MVRp is not superior to MVR with regard to operative and overall mortality in patients with ischemic MR. These findings provide support for the realization of a randomized trial comparing these 2 treatment modalities. (*Circulation*. **2009;120[suppl 1]:S104–S111.**)

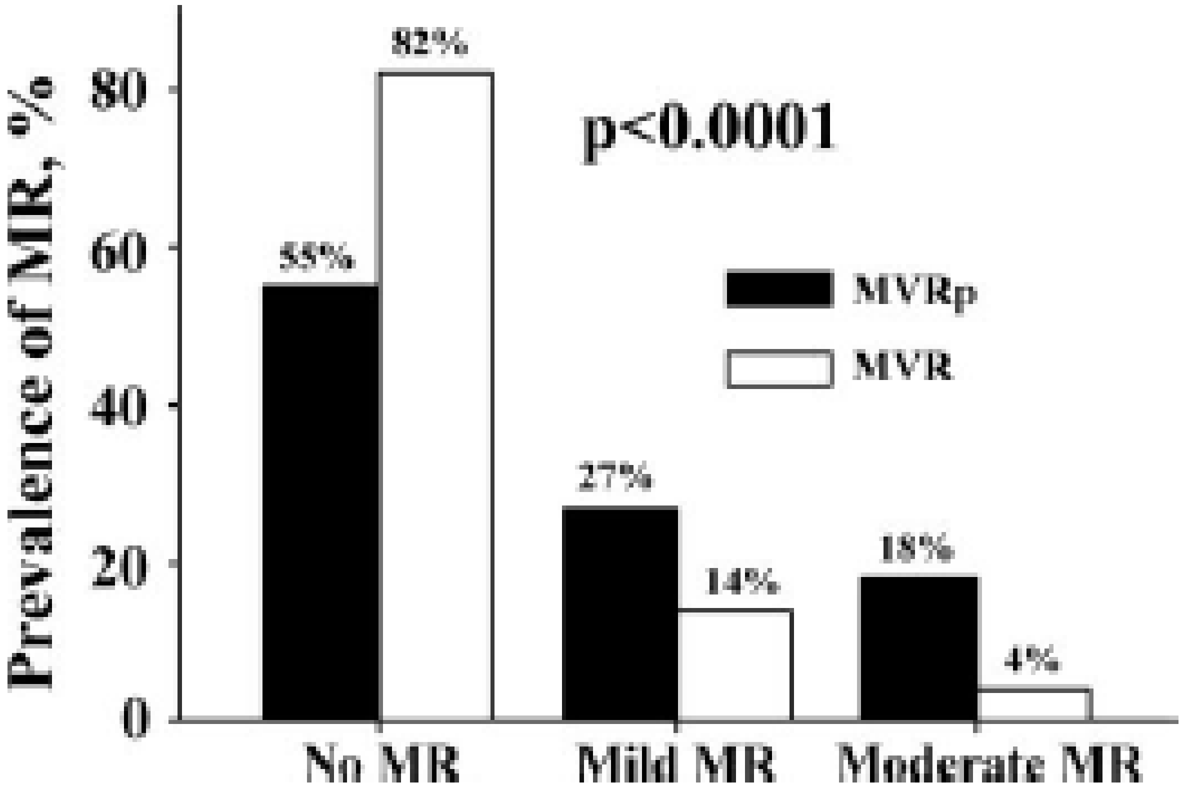


Figure 3. Comparison of the prevalence of persistent MR at predischarge echocardiographic examination in the MVRp and MVR groups.

Clinical Implications

The findings of the present and previous studies[3,5,10,11] underline the importance of tailoring the surgical procedure according to the baseline characteristics of the patient. Several studies have indeed demonstrated that it is possible to predict the risk of persistent MR and, to a lesser extent, the risk of recurrent MR after MVRp from the preoperative echocardiographic evaluation.[3,5,6,19,20] The factors that were identified as independent predictors of MVRp failure in patients with ischemic MR were large LV end-diastolic diameter, mitral annulus diameter, mitral valve tenting area, coaptation distance, and posterior leaflet angle. MVR or alternative procedures targeting the mitral valve apparatus or the LV should be contemplated in the patients identified as being at high risk for MVRp failure based on preoperative echocardiography.

Mitral valve repair versus replacement in patients with ischaemic mitral regurgitation and depressed ejection fraction: risk factors for early and mid-term mortality[†]

Antonio Lio[a], Antonio Miceli[a,b,*], Egidio Varone[a], Daniele Canarutto[a], Gioia Di Stefano[a], Francesca Della Pina[a], Daniyar Gilmanov[a], Michele Murzi[a], Marco Solinas[a] and Mattia Glauber[a]

Interactive CardioVascular and Thoracic Surgery 19 (2014) 64–69

Table 1: Preoperative data

Variables	MV repair (*n* = 98)	MV replacement (*n* = 28)	*P*-value
Age, years ± SD	64.8 ± 10.5	69.7 ± 10	0.029
Female, *n* (%)	26 (26.5)	11 (39.3)	0.28
NYHA class (3–4), *n* (%)	60 (61.2)	20 (71.4)	0.44
Diabetes, *n* (%)	34 (34.7)	9 (32.1)	1
Hypertension, *n* (%)	79 (80.6)	25 (89.3)	0.43
COPD, *n* (%)	14 (14.3)	4 (14.2)	1
Extracardiac arteriopathy, *n* (%)	19 (19.4)	6 (21.4)	1
LVEF (%)	32.1 ± 6.7	34.1 ± 7.1	0.18
LV end-systolic diameter, mm ± SD	47 ± 7.1	44.8 ± 10	0.21
LV end-diastolic diameter, mm ± SD	61.6 ± 6.3	58.6 ± 9.3	0.14
Left atrium diameter, mm ± SD	45.3 ± 5.1	44 ± 6.6	0.2
Previous operations (%)	0 (0)	2 (7.1)	0.07
Critical preoperative state (%)	7 (7.1)	7 (25)	0.021
Recent myocardial infarction (%)	14 (14.3)	5 (17.9)	0.9
Preoperative intra-aortic balloon pump, *n* (%)	18 (18.4)	10 (35.7)	0.66
Pulmonary hypertension	17 (17.3)	9 (32.1)	0.09
No. of coronary lesions, *n* ± SD	2.6 ± 0.7	2.4 ± 0.7	0.52
BNP levels, ng/ml (interquartile range)	966.5 (658–1307)	964.5 (734–2036)	0.32

COPD: chronic obstructive pulmonary disease; LVEF: left ventricular ejection fraction; LV: left ventricle; MV: mitral valve; NYHA: New York Heart Association; SD: standard deviation; BNP: B-type natriuretic peptide.

Mitral valve repair versus replacement in patients with ischaemic mitral regurgitation and depressed ejection fraction: risk factors for early and mid-term mortality[†]

Antonio Lio[a], Antonio Miceli[a,b,*], Egidio Varone[a], Daniele Canarutto[a], Gioia Di Stefano[a], Francesca Della Pina[a], Daniyar Gilmanov[a], Michele Murzi[a], Marco Solinas[a] and Mattia Glauber[a]

Table 4: Univariate and multivariate predictors of mid-term survival

Variables	Univariate model		Multivariate model	
	P	HR (95% CI)	*P*	HR (95% CI)
Age, per year	0.03	1.09 (1.03–1.16)	0.07	1.06 (0.99–1.13)
Sex, male	0.72	1.2 (0.5–3)	–	–
Body surface area	0.49	1.7 (0.4–6.9)	–	–
Hypertension	0.25	2.3 (0.5–9.8)	–	–
Diabetes	0.63	1.2 (0.5–2.8)	–	–
Renal failure	0.02	4.2 (1.2–14.1)	0.039	4.6 (1.1–20.3)
Extracardiac arteriopathy	0.75	0.8 (0.28–2.5)	–	–
Atrial fibrillation	0.006	3.3 (1.4–7.7)	0.032	3.3 (1.1–10)
Pulmonary hypertension	0.17	1.8 (0.75–4.5)	0.15	2.3 (0.7–7.1)
Recent myocardial infarction	0.85	0.9 (0.25–3)	–	–
LVEF, per %	0.06	0.95 (0.9–1.01)	0.09	0.93 (0.87–1.01)
LV end-systolic diameter(mm)	0.017	0.93 (0.88–0.98)	0.23	0.94 (0.85–1.04)
LV end-diastolic diameter (mm)	0.033	0.94 (0.88–0.99)	0.9	1.001 (0.9–1.11)
Left atrium diameter (mm)	0.63	1.02 (0.94–1.1)	–	–
BNP levels (ng/ml)	<0.0001	1.0 (1.0–1.01)	0.047	1.0 (1.0–1.01)
MVR versus MVRp	0.09	2.1 (0.9–4.8)	0.97	0.98 (0.3–2.9)

LVEF: left ventricular ejection fraction; LV: left ventricle; BNP: B-type natriuretic peptide; MVR: mitral valve replacement; HR: hazards ratio; CI: confidence interval.

CONCLUSIONS: MV repair in CABG patients with IMR and depressed LVEF is not superior to MV replacement with regard to operative early mortality and mid-term survival.

Mitral valve repair versus replacement in patients with ischaemic mitral regurgitation and depressed ejection fraction: risk factors for early and mid-term mortality[†]

Antonio Lio[a], Antonio Miceli[a,b,*], Egidio Varone[a], Daniele Canarutto[a], Gioia Di Stefano[a], Francesca Della Pina[a], Daniyar Gilmanov[a], Michele Murzi[a], Marco Solinas[a] and Mattia Glauber[a]

Table 2: Operative data

Variables	MV repair (*n* = 98)	MV replacement (*n* = 28)	*P*-value
CPB time (min ± SD)	156 ± 46	180 ± 79	0.10
Cross-clamp time (min ± SD)	107 ± 29	132 ± 47	0.002
CABG (no. of grafts)	2.5 ± 0.9	2.2 ± 0.9	0.47
Prosthesis type			
Mechanical, *n* (%)		10 (36)	
Bioprosthesis, *n* (%)		18 (64)	
Ring type			
Open ring, *n* (%)	36 (37)		
Closed ring, *n* (%)	62 (63)		
Rigid ring, *n* (%)	36 (37)		
Semi-rigid ring, *n* (%)	62 (63)		

CPB: cardiopulmonary bypass; CABG: coronary artery bypass grafting; MV: mitral valve; SD: standard deviation.

Meta-analysis of short-term and long-term survival following repair versus replacement for ischemic mitral regurgitation

Christina M. Vassileva*, Theresa Boley, Stephen Markwell, Stephen Hazelrigg

European Journal of Cardio-thoracic Surgery 39 (2011) 295—303

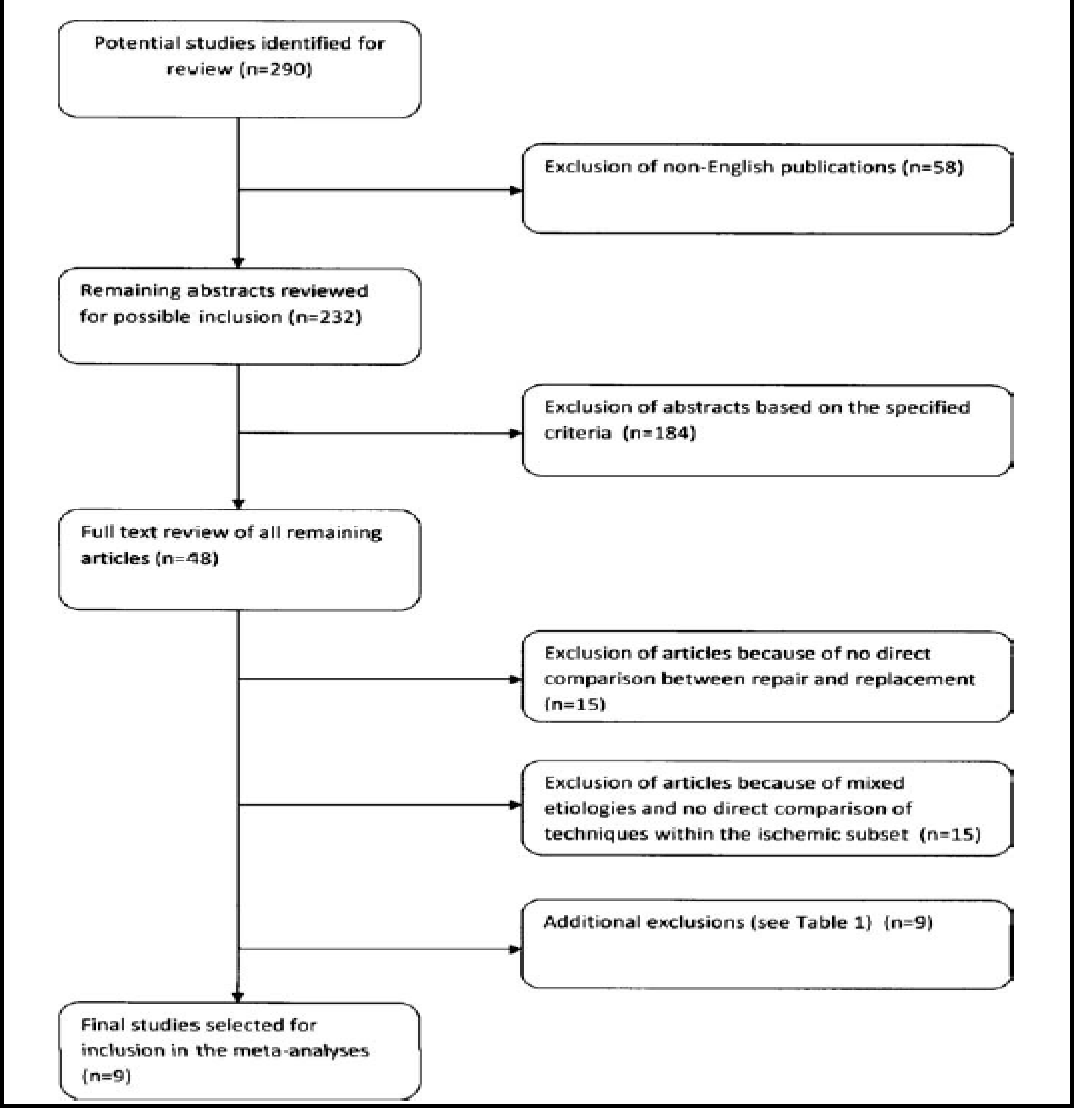


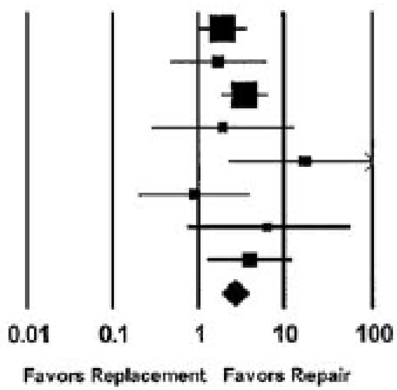
Table 1. Rationale for exclusion of selected publications.

Study	Rationale for exclusion
Gillinov et al. [22]	No direct overall comparison of MVP and MVR, 28% of repair patients with bovine pericardial strip, 9% of patients with ruptured papillary muscle
Rankin et al. [26]	No survival curves or hazard ratios, 22% of repair patients with suture annuloplasty, 70% of repair patients with transventricular mitral repair without ring placement, 16% of patients with papillary muscle rupture
Calafiore et al. [21]	18% of repair patients with suture annuloplasty, 76% of repair patients with pericardial strip
Hausmann et al. [23]	No annuloplasty ring used in any of the repairs
Hausmann et al. [24]	No annuloplasty ring used in any of the repairs
Oury et al. [28]	20% of patients with hemodynamical instability, 62% of patients with rheumatic + infectious + degenerative etiology of MR
Cohn et al. [25]	15% of repairs without an annuloplasty ring, 10% of patients with degenerative mitral valve regurgitation, 19% of patients with complete or partial papillary muscle rupture
Kay et al. [27]	No annuloplasty ring used in any of the repairs
Bonacchi et al. [20]	17% of repairs without an annuloplasty ring
Grossi et al. [19]	23% of repair patients with suture annuloplasty, 5% of patients with cardiogenic shock

Short-term Survival

Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value
	Statistics for each study				
Magne (2009)	1.965	1.058	3.647	2.140	0.032
Micovic (2008)	1.724	0.475	6.260	0.828	0.408
Milano (2008)	3.484	1.860	6.528	3.897	0.000
Silberman (2006)	1.946	0.288	13.123	0.683	0.494
Al-Radi (2005)	17.241	2.330	127.575	2.788	0.005
Montavani (2004)	0.884	0.199	3.921	-0.162	0.871
Reece (2004)	6.369	0.735	55.202	1.680	0.093
Hickey (1988)	3.937	1.272	12.189	2.377	0.017
Pooled Effect	2.664	1.859	3.817	5.337	0.000

Odds ratio and 95% CI

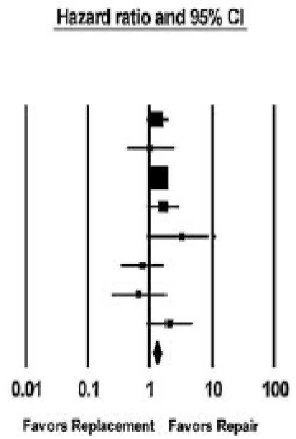


Significantly increased likelihood of short-term mortality associated with mitral valve replacement

Long-term Survival

Study name	Hazard ratio	Lower limit	Upper limit	Z-Value	p-Value
Magne (2009)	1.339	0.915	1.960	1.501	0.133
Micovic (2008)	1.036	0.438	2.450	0.080	0.937
Milano (2008)	1.368	1.057	1.769	2.383	0.017
Ngaage (2008)	1.649	0.945	2.875	1.762	0.078
Silberman (2006)	3.206	0.919	11.183	1.828	0.068
Al-Radi (2005)	0.768	0.340	1.737	-0.634	0.526
Montavani (2004)	0.668	0.245	1.821	-0.789	0.430
Hickey (1988)	2.044	0.902	4.634	1.712	0.087
Pooled Effect	1.352	1.131	1.618	3.304	0.001

Statistics for each study



Significantly increased likelihood of long-term mortality associated with mitral valve replacement

5. Conclusion

Based on the meta-analysis of the current relevant literature, mitral valve repair for IMR is associated with better short-term and long-term survival compared with mitral valve replacement. Our conclusion should be interpreted in the context of the inherent limitations of a meta-analysis of retrospective studies including heterogeneity of patient characteristics, which may have influenced the physician's decision to perform mitral valve repair or replacement. Prospective randomized trials are needed to definitively settle this controversy. Until then, mitral procedure selection should be individualized. An appropriate patient selection based on specific echocardiographic criteria to minimize the risks of persistent and/or recurrent MR would likely lead to even further improvement in outcomes with mitral valve repair for patients with IMR.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Mitral-Valve Repair versus Replacement for Severe Ischemic Mitral Regurgitation

Michael A. Acker, M.D., Michael K. Parides, Ph.D., Louis P. Perrault, M.D., Alan J. Moskowitz, M.D., Annetine C. Gelijns, Ph.D., Pierre Voisine, M.D., Peter K. Smith, M.D., Judy W. Hung, M.D., Eugene H. Blackstone, M.D., John D. Puskas, M.D., Michael Argenziano, M.D., James S. Gammie, M.D., Michael Mack, M.D., Deborah D. Ascheim, M.D., Emilia Bagiella, Ph.D., Ellen G. Moquete, R.N., T. Bruce Ferguson, M.D., Keith A. Horvath, M.D., Nancy L. Geller, Ph.D., Marissa A. Miller, D.V.M., Y. Joseph Woo, M.D., David A. D'Alessandro, M.D., Gorav Ailawadi, M.D., Francois Dagenais, M.D., Timothy J. Gardner, M.D., Patrick T. O'Gara, M.D., Robert E. Michler, M.D., and Irving L. Kron, M.D., for the CTSN*

The rate of moderate or severe recurrence of mitral regurgitation at 12 months was higher in the repair group than in the replacement group (32.6% vs. 2.3%, P<0.001). There were no significant

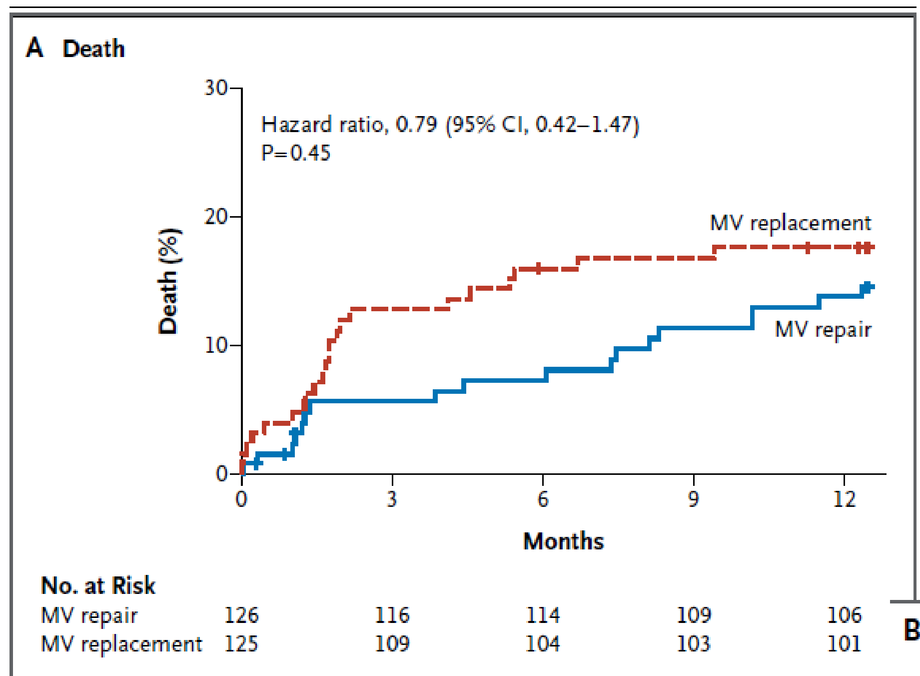
N Engl J Med 2014;370:23-32.

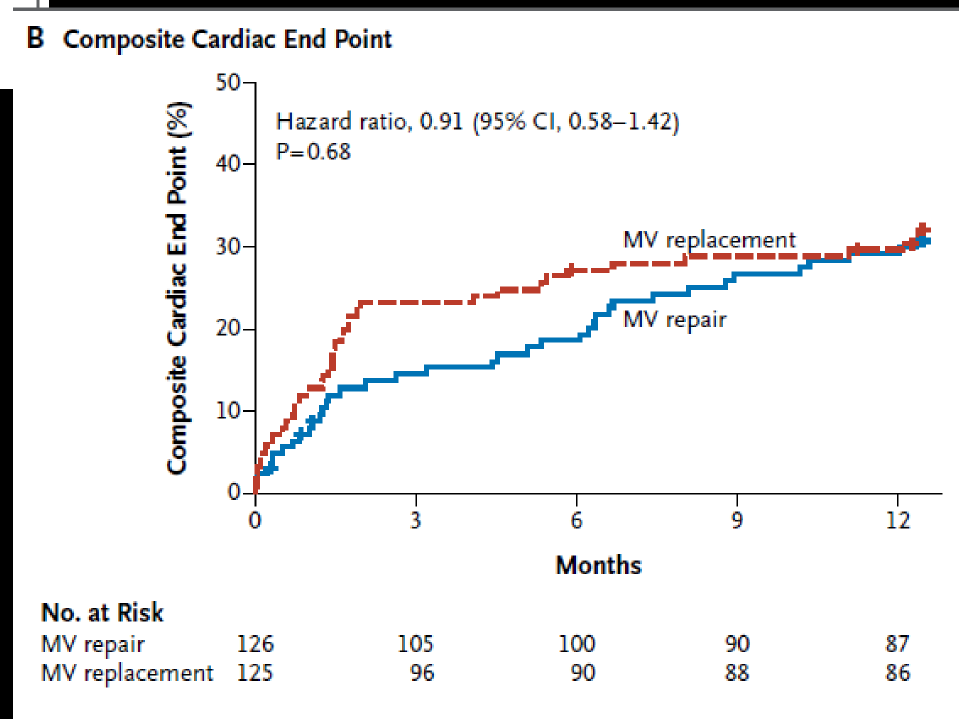
END POINTS

The primary end point of the trial was the degree of left ventricular reverse remodeling, as assessed by means of the left ventricular end-systolic volume index (LVESVI) on the basis of transthoracic echocardiography performed 12 months after randomization. The LVESVI was verified by the echocardiography core laboratory. Secondary end points included mortality, a composite of major adverse cardiac or cerebrovascular events (rate of death, stroke, subsequent mitral-valve surgery, hospitalization for heart failure, or an increase in New York Heart Association [NYHA] class of ≥1), serious adverse events, recurrent mitral regurgitation, quality of life, and rehospitalization.

LEFT VENTRICULAR DIMENSION AND FUNCTION

At 12 months, the mean LVESVI among surviving patients was 54.6±25.0 ml per square meter in the repair group and 60.7±31.5 ml per square meter in the replacement group (mean change from baseline, −6.6 ml and −6.8 ml per square meter, respectively). The rate of death was 14.3% in the repair group and 17.6% in the replacement group (hazard ratio with repair, 0.79; 95% confidence interval [CI], 0.42 to 1.47; P=0.45 by the


A Death
Hazard ratio, 0.79 (95% CI, 0.42–1.47)
P=0.45
Death (%)
30
20
10
0
MV replacement
MV repair
0
3
6
9
12
Months
No. at Risk
MV repair 126 116 114 109 106
MV replacement 125 109 104 103 101


B Composite Cardiac End Point
Hazard ratio, 0.91 (95% CI, 0.58–1.42)
P=0.68
Composite Cardiac End Point (%)
50
40
30
20
10
0
MV replacement
MV repair
0
3
6
9
12
Months
No. at Risk
MV repair 126 105 100 90 87
MV replacement 125 96 90 88 86

POINT: Efficacy of adding mitral valve restrictive annuloplasty to coronary artery bypass grafting in patients with moderate ischemic mitral valve regurgitation: A randomized trial

Khalil Fattouch, MD, PhD, Francesco Guccione, MD, Roberta Sampognaro, MD, Gaetano Panzarella, MD,

J Thorac Cardiovasc Surg 2009;138:278-285

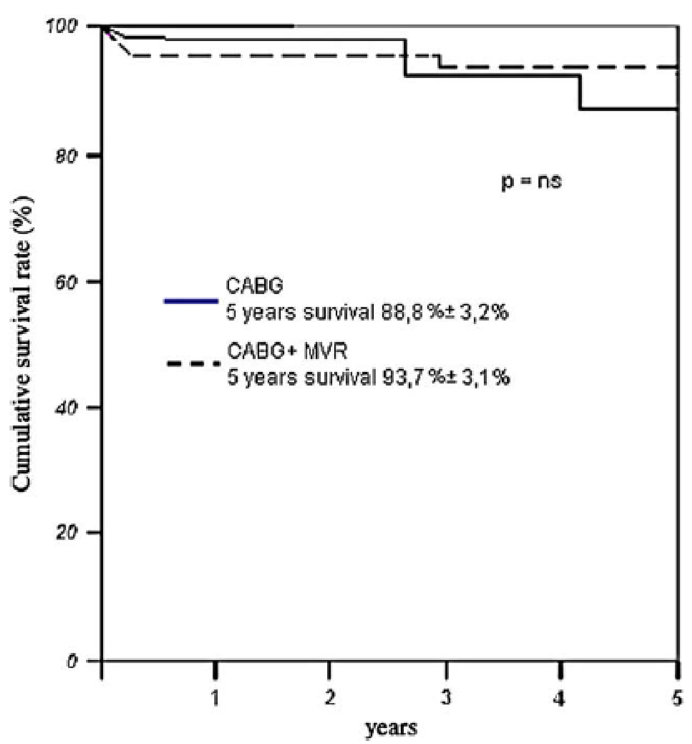


FIGURE 1. Cumulative survival curves for both groups. *CABG*, Coronary artery bypass grafting; *MVR*, mitral valve repair.

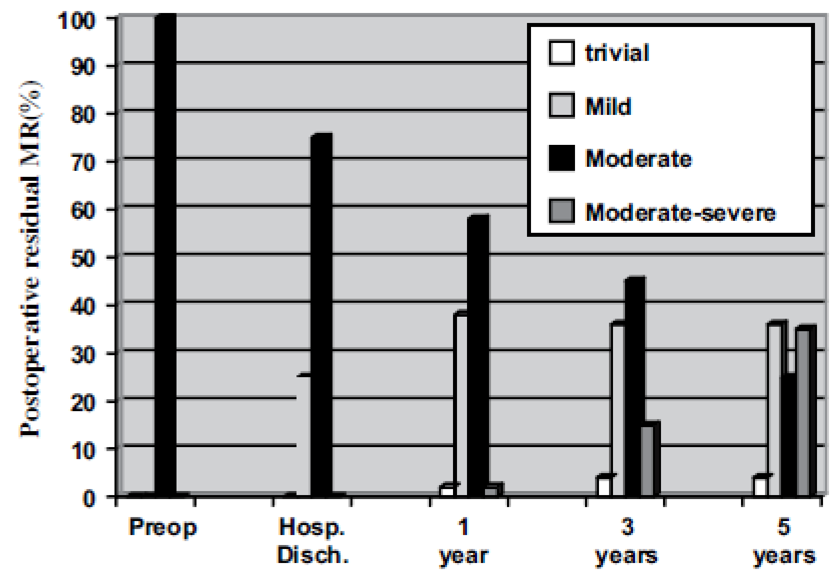


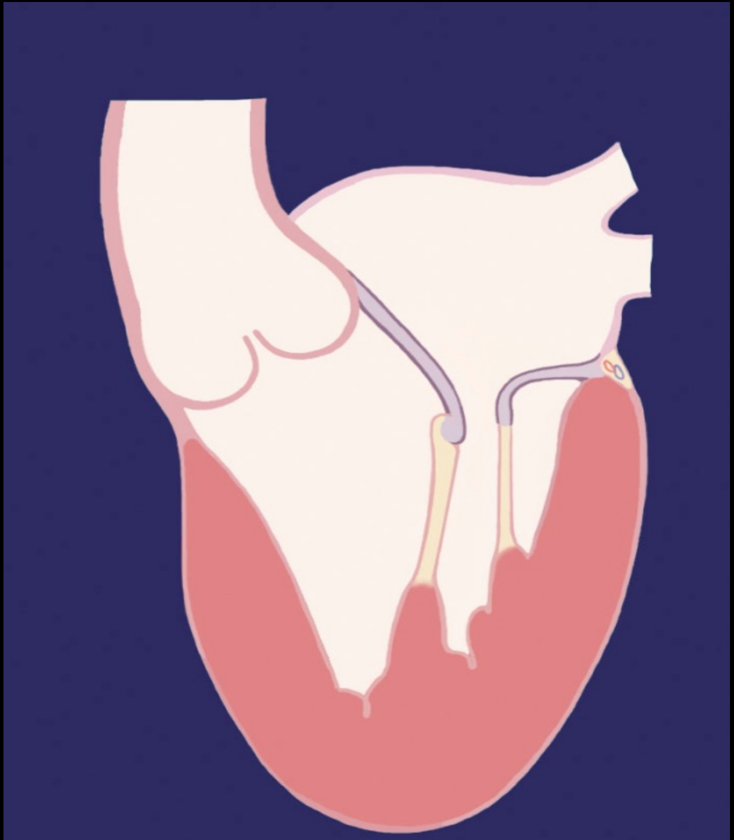
FIGURE 2. Residual postoperative mitral regurgitation *(MR)* in the coronary artery bypass grafting group during follow-up.

TABLE 3. Clinical and echocardiographic follow-up data in all survivors

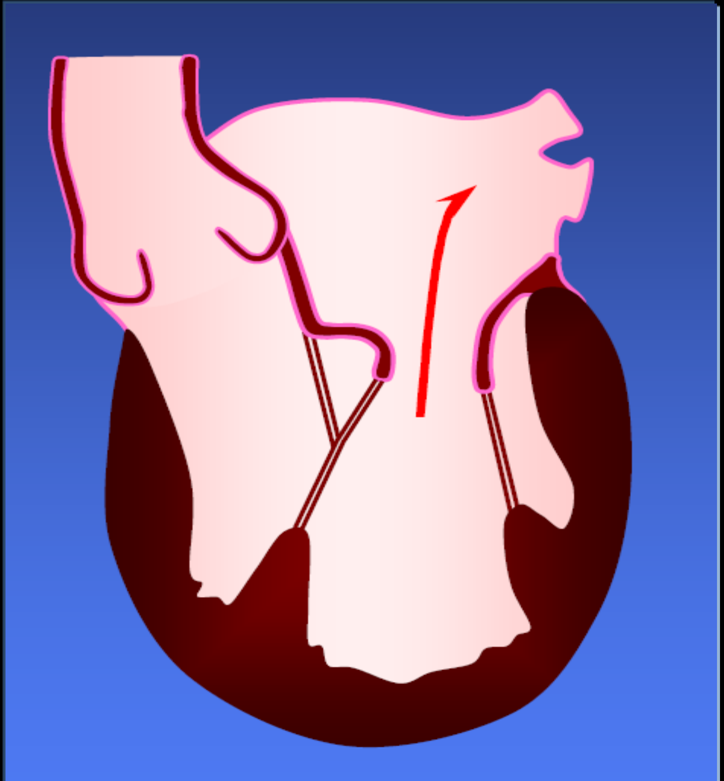
	CABG group (n = 48)			CABG+MVR group (n = 45)		
	Baseline	Follow-up	*P* value	Baseline	Follow-up	*P* value
LVEDD (mm)	58 ± 7	56 ± 8	NS	59 ± 8	52 ± 7*	<.001
LVESD (mm)	44 ± 7	42 ± 8	NS	45 ± 8	37 ± 5*	<.001
LVEF (%)	43 ± 9	45 ± 7	NS	42 ± 10	48 ± 8	<.001
sPAP (mm Hg)	42 ± 11	38 ± 12	NS	40 ± 10	26 ± 5†	<.0001
Left atrial size (mm)	38 ± 7	44 ± 8	<.001	39 ± 8	36 ± 3*	NS
Tenting area (cm^2)	1.7 ± 0.7	1.8 ± 0.3	NS	1.8 ± 0.6	1.1 ± 0.3*	<.001
Mean NYHA class	2.2 ± 1.5	1.6 ± 0.6	.002	2.3 ± 1.1	0.6 ± 0.8†	<.0001
Mean MR grade	2	1.7 ± 0.6	NS	2	0.08 ± 0.2†	<.0001

Data are presented as means ± standard deviation or number (%), as shown. *CABG*, Coronary artery bypass grafting; *MVR*, mitral valve repair; *LVEDD*, left ventricular end-diastolic dimension; *LVESD*, left ventricular end-systolic dimension; *LVEF*, left ventricular ejection fraction; *sPAP*, systolic pulmonary artery pressure; *NYHA*, New York Heart Association functional class; *MR*, mitral regurgitation. *$P < .01$ versus the CABG group. †$P < .0001$ versus the CABG group.

Carpentier's Functional classification of IMR



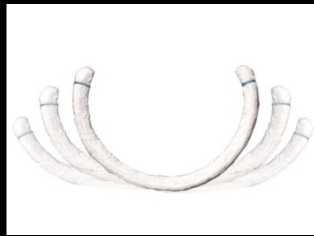
Type I – annular dilatation



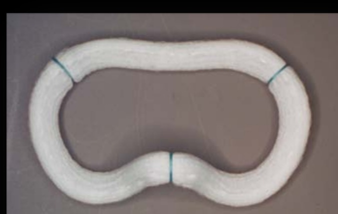
Type IIIb
Leaflet restriction

Surgical treatment

- Undersizing annuloplasty is the most popular technique used to treat IMR
- Uncertaintly remains on the ideal type of ring to be used

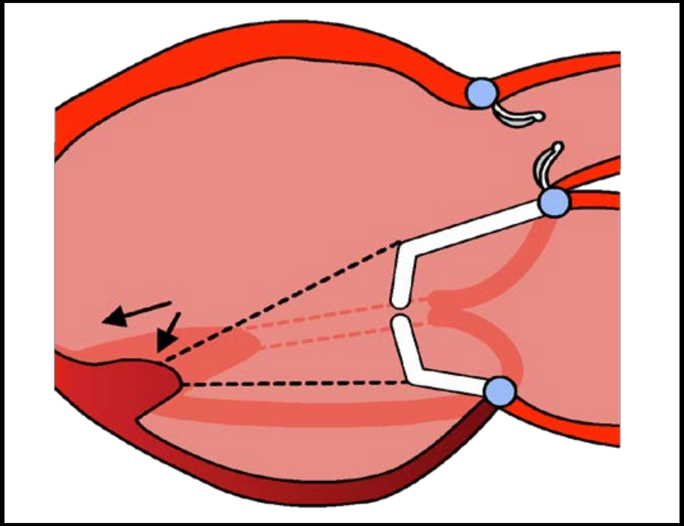


RING WARS




THE LORD OF THE RINGS
THE RETURN OF THE KING
DECEMBER 17TH
America Online Keyword: Lord of the Rings
www.lordoftherings.net

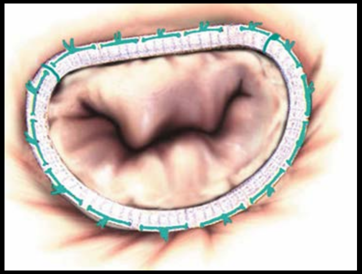
The "RING and RUN" approach
Undersizing annuloplasty for all cases?

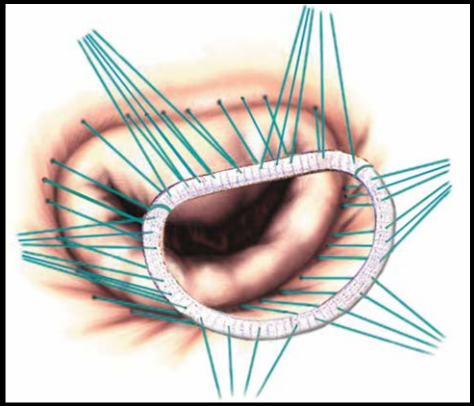


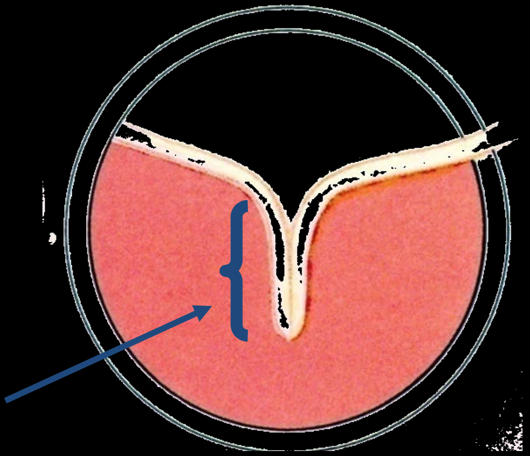
AN ANNULAR SOLUTION TO

A VENTRICULAR PROBLEM

?

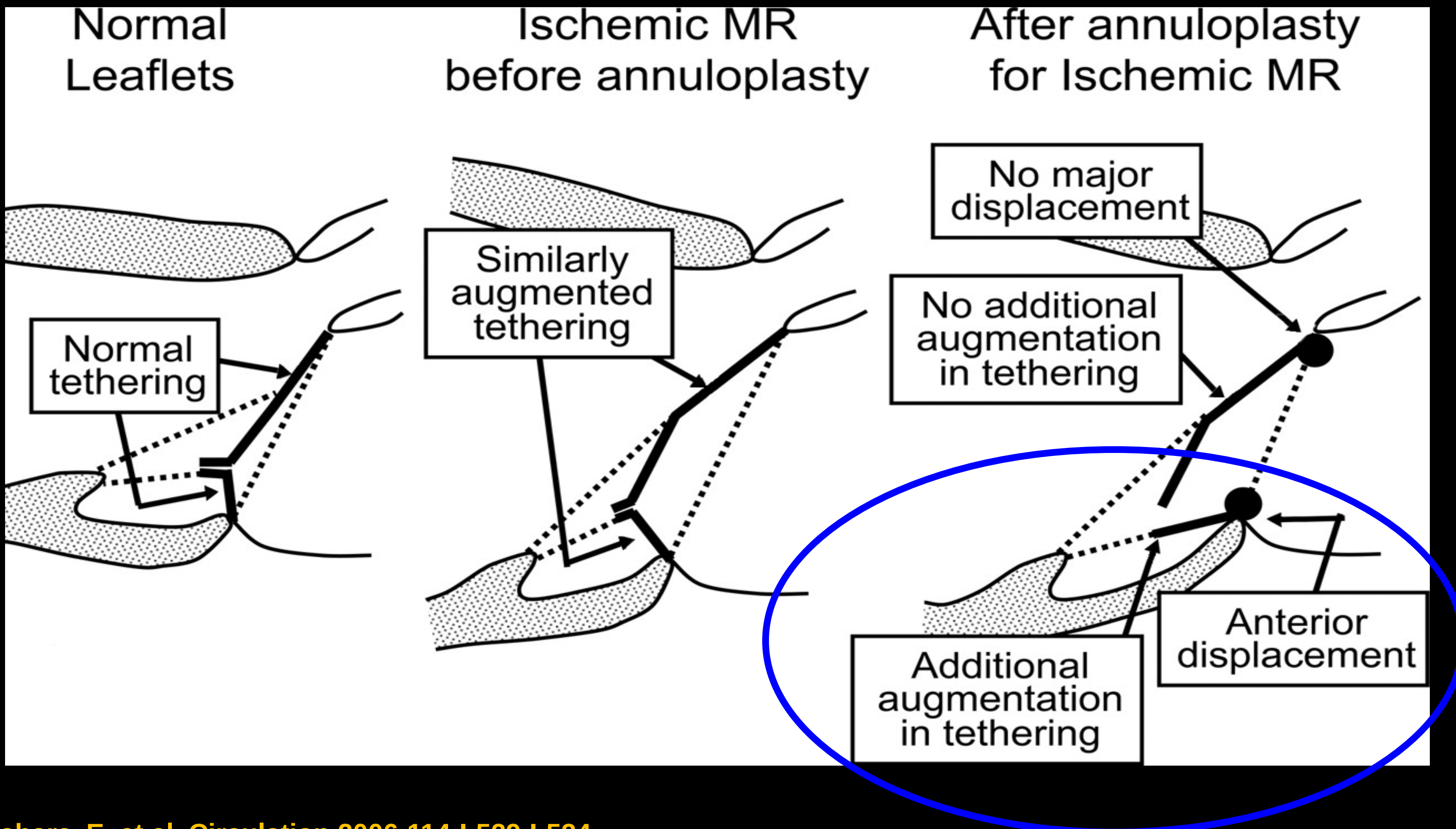






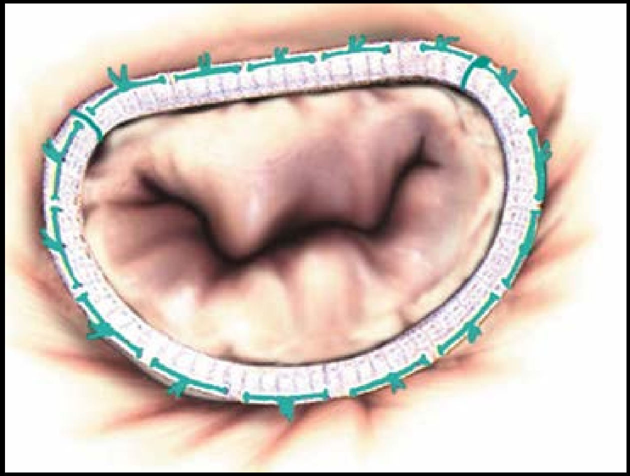
Coaptation Reserve
> = 8 mm

Mecchanism of recurrent MR after annuloplasty



Kuwahara, E. et al. Circulation 2006;114:I-529-I-534

Echocardiographic Predictors for recurrent MR After restrictive annuloplasty	Authors/Reference
Systolic tenting area > 2.5 cm2	Lesniak-Sobelga et al; Kongsaerepong et al.
Coaptation depth/height > 10mm	Gelsomino et al, Calafiore et al, Ciarka et al.
Posterior angle (β) > 45°	Kuwahara et al, Ciarka et al.
Distal anterior angle (α) > 25°	Gelsomino et al, Magne et al, Ciarka et al.
Sphericity index > 0.7	Ciarka et al.
End-systolic inter-papillary muscles distance > 20mm	Roshanali et al.
LV end-dyastolic diameters and volumes	Dion et al, Braun et al, Onorati et al.
Left ventricle dyssynchrony	Van Garsse et al.

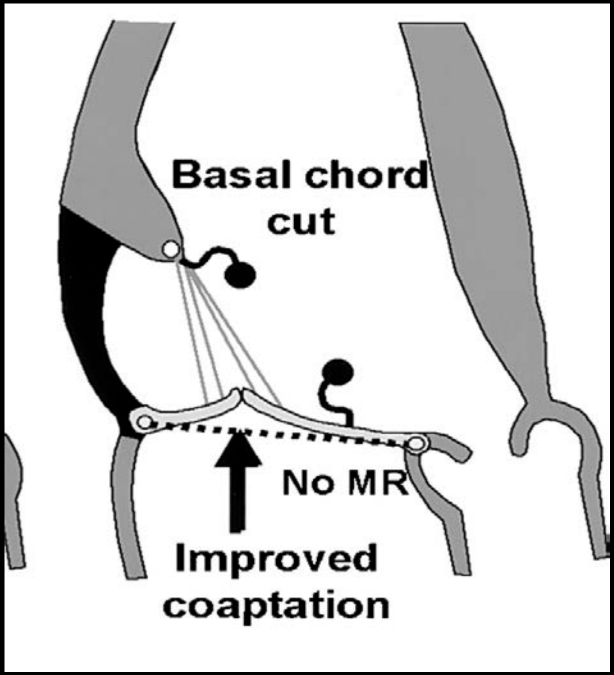


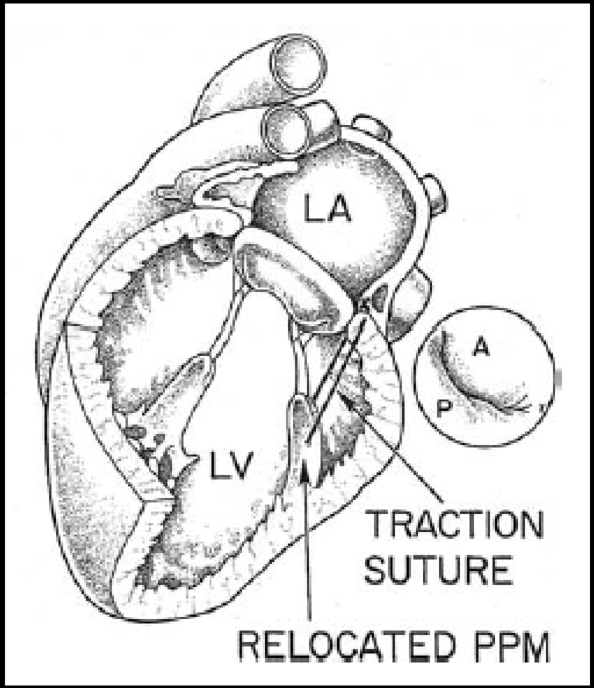
Mitral annuloplasty doesn’t mean mitral valve repair

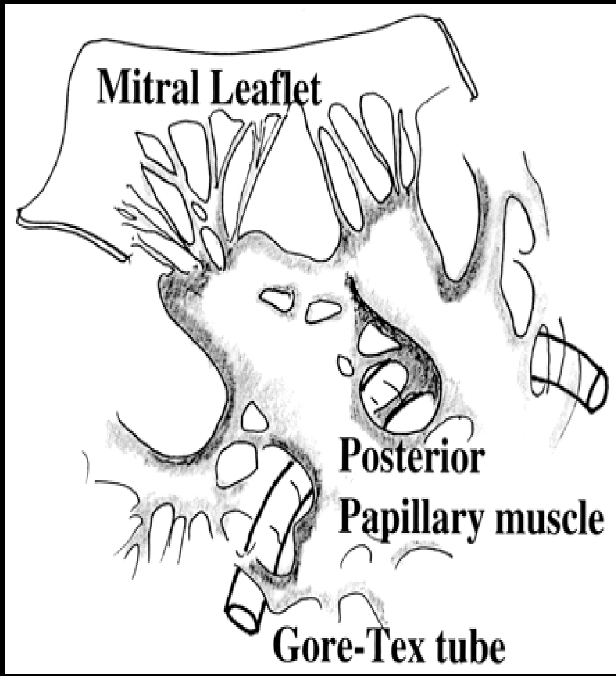
Attemps to improve durability of MVR in IMR

Sub-anular procedures

(Chordal Cutting, PPM relocation, PPM sling)







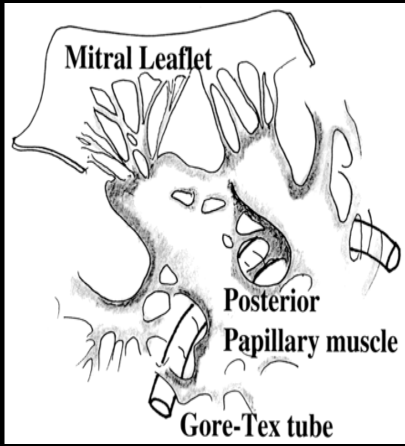
Chordal Cutting: A New Therapeutic Approach for Ischemic Mitral Regurgitation
Emmanuel Messas, J. Luis Guerrero, Mark D. Handschumacher, Chris Conrad, Chi-Ming Chow, Suzanne Sullivan, Ajit P. Yoganathan and Robert A. Levine
Circulation 2001;104;1958-1963

Surgical relocation of the posterior papillary muscle in chronic ischemic mitral regurgitation
Irving L. Kron, G. Randall Green and Jeffrey T. Cope
Ann Thorac Surg 2002;74:600-601

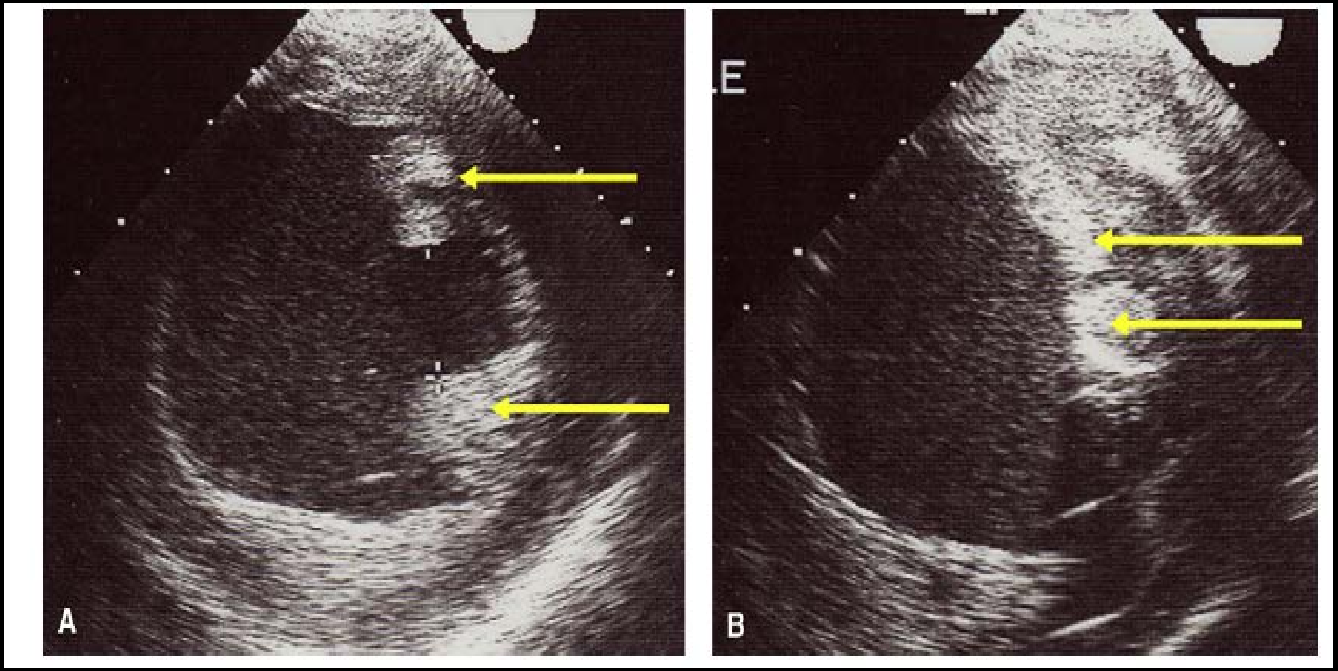
Papillary muscle sling: a new functional approach to mitral repair in patients with ischemic left ventricular dysfunction and functional mitral regurgitation
Ulrik Hvass, Michel Tapia, Frank Baron, Bruno Pouzet and Abdel Shafy
Ann Thorac Surg 2003;75:809-811

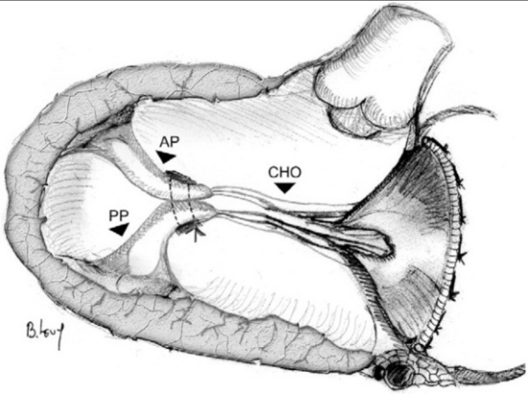
The papillary muscle sling for ischemic mitral regurgitation

Ulrik Hvass, MD, and Thomas Joudinaud, MD



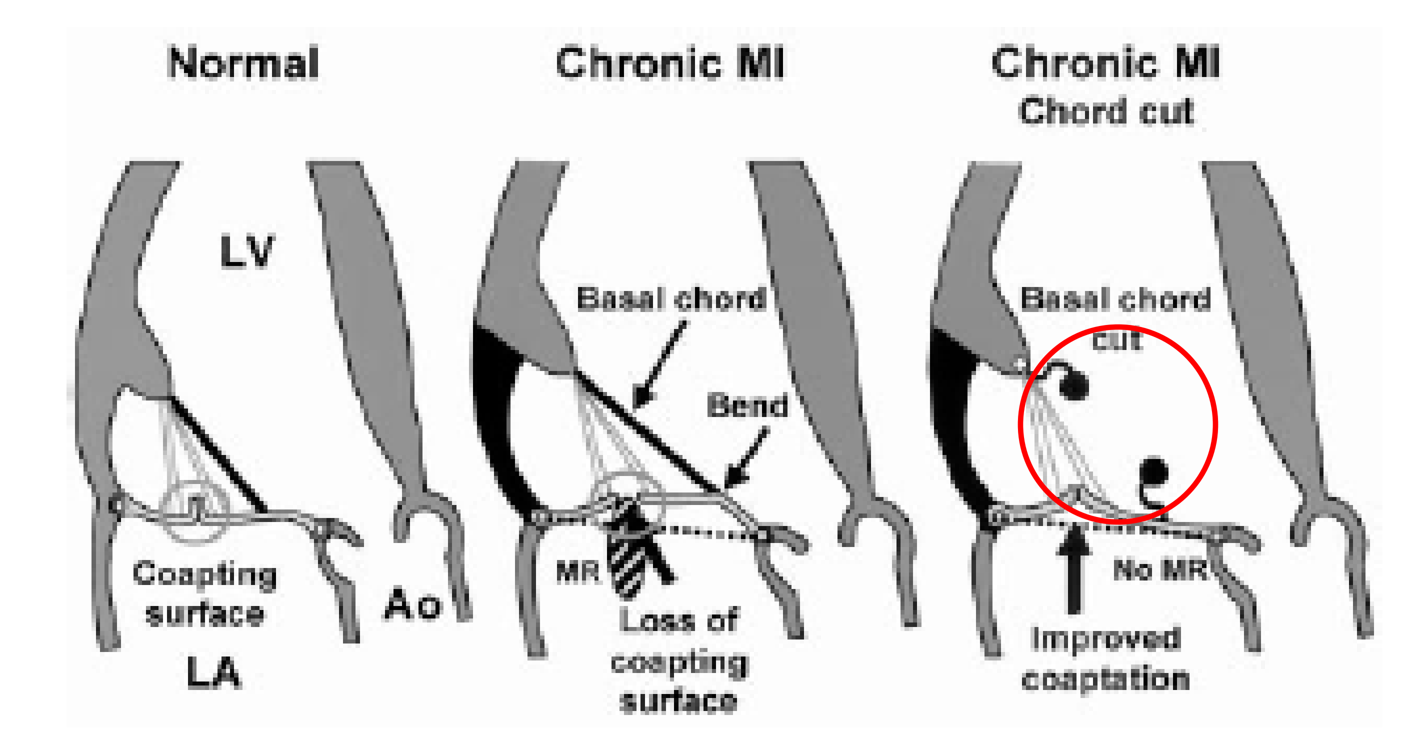
Conclusion: Reapproximating the papillary muscles has an immediate effect on mitral leaflet mobility by suppressing the tethering resulting from displacement of the papillary muscles. It has an effect in preventing recurrent mitral regurgitation by avoiding further papillary muscle displacement. In this cohort of severely disabled patients, reverse remodeling can be expected with the double-level repair. (J Thorac Cardiovasc Surg 2010;139:418-23)





Efficacy of Chordal Cutting to Relieve Chronic Persistent Ischemic Mitral Regurgitation

Emmanuel Messas, MD, MSc; Bruno Pouzet, MD; Bernard Touchot, MD; J. Luis Guerrero, BS; Gus J. Vlahakes, MD; Michel Desnos, MD; Philippe Menasché, MD, PhD; Albert Hagège MD, PhD; Robert A. Levine, MD



(*Circulation*. 2003;108[suppl II]:II-111-II-115.)

Relief of Mitral Leaflet Tethering Following Chronic Myocardial Infarction by Chordal Cutting Diminishes Left Ventricular Remodeling

Emmanuel Messas, MD, PhD[1], Alain Bel, MD[1], Catherine Szymanski, MD[1], Iris Cohen, MD[1], Bernard Touchot, MD[1], Mark D. Handschumacher, BS[2], Michel Desnos, MD[1], Alain Carpentier, MD, PhD[1], Philippe Menasché, MD, PhD[1], Albert A Hagège, MD, PhD[1], and Robert A. Levine, MD[2]

Circ Cardiovasc Imaging. 2010 November 1; 3(6): 679–686.

Conclusions—Reduced leaflet tethering by chordal cutting in the chronic post-MI setting substantially decreases the progression of LV remodeling with sustained reduction of MR over a chronic follow-up. These benefits have the potential to improve clinical outcomes.

Initial results of the chordal-cutting operation for ischemic mitral regurgitation

Michael A. Borger, MD, PhD, Patricia M. Murphy, MD, Asim Alam, MD, Shafie Fazel, MD, PhD, Manjula Maganti, MSc, Susan Armstrong, MSc, Vivek Rao, MD, PhD, and Tirone E. David, MD

J Thorac Cardiovasc Surg 2007;133:1483-92

TABLE 4. Intraoperative transesophageal echocardiographic measurements

Variable	Control (n = 39)	Chordal cutting (n = 36)	*P* value
Mitral annular diameter (mm)	34 ± 1	35 ± 1	.3
Tent area (cm^2)	2.5 ± 0.2	2.9 ± 0.2	.14
AMVL–posterior LV (mm)	24 ± 9	21 ± 6	.2
Prerepair to postrepair reduction			
Mitral annulus	28% ± 3%	33% ± 2%	.2
Tent height	20% ± 3%	24% ± 4%	.4
Tent area	41% ± 3%	53% ± 3%	.01
AMVL–posterior LV	11% ± 4%	24% ± 3%	.01

Conclusion: Chordal cutting improves mitral valve leaflet mobility and reduces mitral regurgitation recurrence in patients with ischemic mitral regurgitation, without any obvious deleterious effects on left ventricular function.

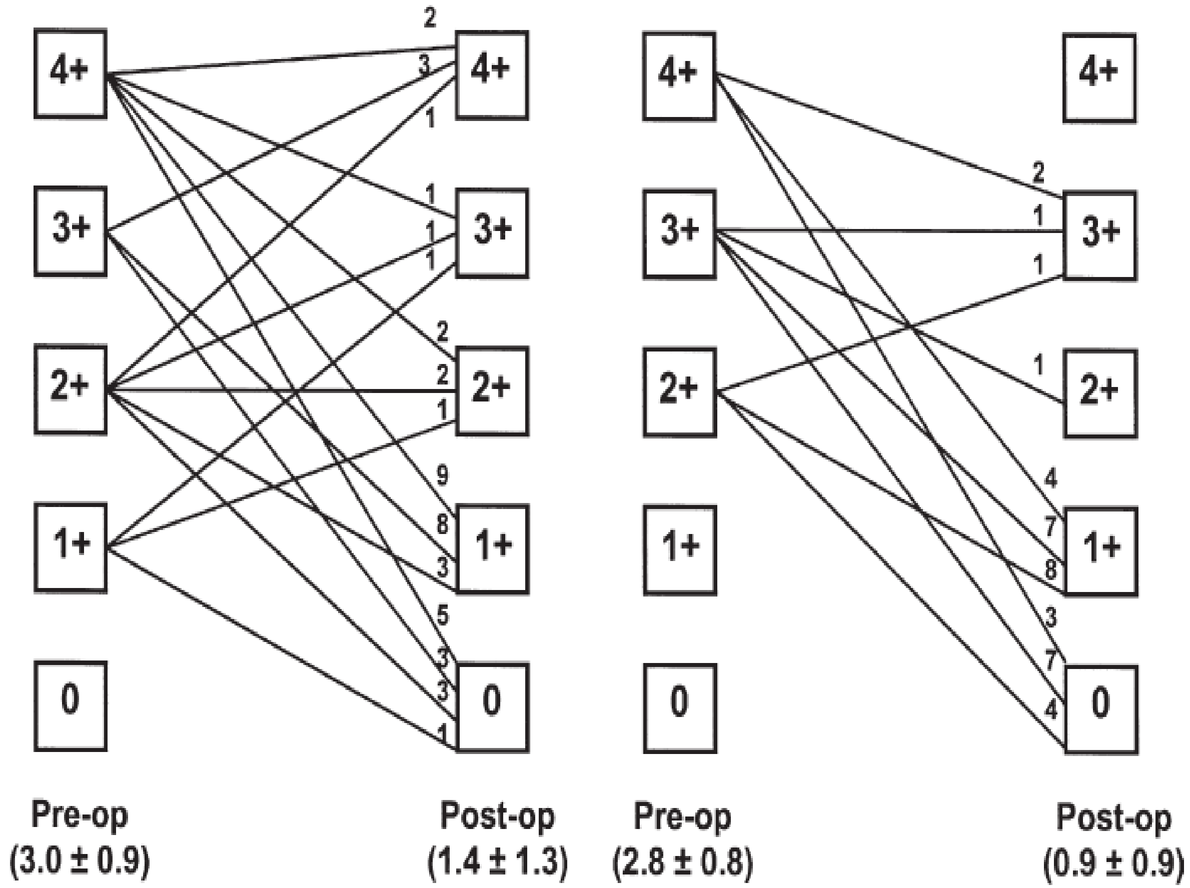


Figure 1. Grade of MR preoperatively and during follow-up in the control group *(left)* and the chordal-cutting group *(right)*. Both groups showed a significant reduction in the grade of MR from before to after surgery ($P < .001$). Preoperative MR grade was similar between groups, but postoperative MR grade was lower in the chordal-cutting group ($P = .04$). *MR*, mitral regurgitation.

Control group
14 pts ≥ moderate MR

Chordal cutting group
5 pts ≥ moderate MR

Chordal cutting in ischemic mitral regurgitation: A propensity-matched study

Antonio M. Calafiore, MD,[a] Reda Refaie, MD,[a] Angela L. Iacò, MD,[a] Mahmood Asif, MD,[a] Heythem S. Al Shurafa, MD,[b] Hussein Al-Amri, MD,[b] Antonella Romeo, MD,[c] and Michele Di Mauro, MD[a,d]

Conclusions: In selected patients with a BA <145° and coaptation depth ≤10 mm, CC is related to less MR return or persistence, improved EF, and lower New York Heart Association class. (J Thorac Cardiovasc Surg 2014;148:41-6)

TABLE 1. Preoperative clinical and echocardiographic data

Variable	CC group (n = 26)	No-CC group (n = 26)	*P* value
Age (y)	61 ± 9	62 ± 10	.706
Female gender (n)	9	8	1.000
NYHA class	2.7 ± 0.6	2.6 ± 0.7	.583
EuroSCORE	8.1 ± 3.9	7.5 ± 4.6	.614
Diabetes mellitus (n)	15	18	.565
Previous AMI (n)			1.000
Anterior	20	19	
Inferior	6	7	
EF (%)	31 ± 5	29 ± 8	.285
LVEDD (mm)	56 ± 7	57 ± 11	.697
LVESD (mm)	43 ± 8	44 ± 11	.709
Coaptation depth (mm)	9.1 ± 0.6	8.9 ± 0.7	.274
Coaptation length (mm)	3.2 ± 0.7	3.5 ± 1.1	.246
MR grade (1-4)	3.6 ± 0.6	3.3 ± 0.8	.132
PAPs (mm Hg)	47 ± 10	52 ± 13	.126
Mitral leaflet tethering (°)			
α	50 ± 6	49 ± 7	.274
β	44 ± 5	45 ± 8	.591
BA	137 ± 4	137 ± 6	1.000
α/β	1.13 ± 0.3	1.09 ± 0.3	.633
α Excursion	13 ± 9	14 ± 8	.612
β Excursion	26 ± 12	27 ± 9	.735
Proximal AL (mm)	14 ± 2	14 ± 2	1.000
Distal AL (mm)	13 ± 2	14 ± 3	.163

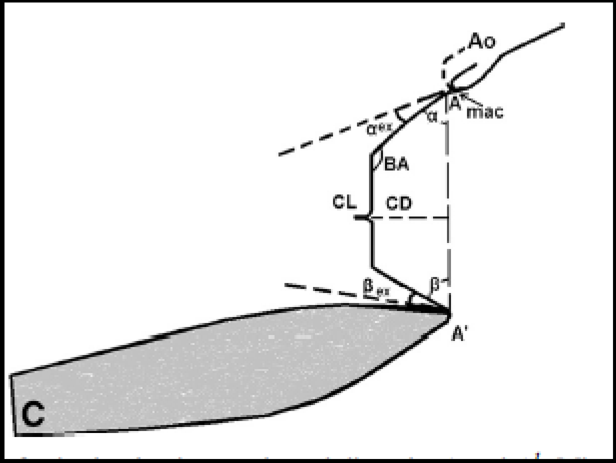


TABLE 2. Surgical details

Variable	CC (n = 26)	No-CC (n = 26)	*P* value
SMB40 (n)	26	—	NA
Physioring (n)	—	26	NA
CABG (n)	26	26	1.000
TV surgery (n)	10	2	.021

CC, Chordal cutting; *No-CC*, no chordal cutting; *NA*, not applicable; *CABG*, coronary artery bypass grafting; *TV*, tricuspid valve.

Cutting second chordae impair ventricular function

Influence of Anterior Mitral Leaflet Second-Order Chordae Tendineae on Left Ventricular Systolic Function

Sten Lyager Nielsen, MD, PhD; Tomasz A. Timek, MD; G. Randall Green, MD;

Anterior Chordal Transection Impairs Not Only Regional Left Ventricular Function But Also Regional Right Ventricular Function in Mitral Regurgitation

Thierry Le Tourneau, MD; Daniel Grandmougin, MD; Claude Foucher, MD;
Eugene P. McFadden, MRCPI; Pascal de Groote, MD; Alain Prat, MD;
Henri Warembourg, MD; Ghislaine Deklunder, MD, PhD

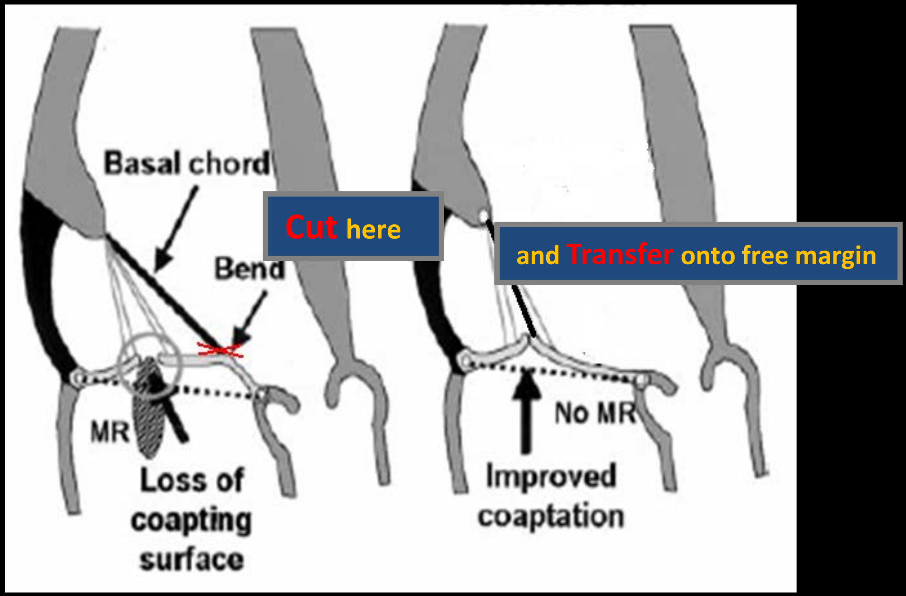
chordae because this may compromise LV systolic function in ventricules that are already impaired

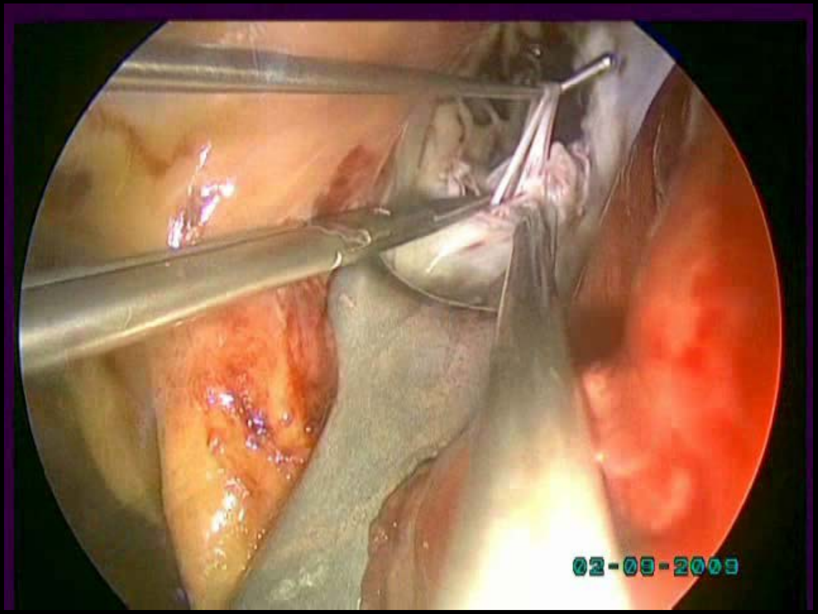
(*Circulation*. 2001;104[suppl I]:I-41-I-46.)

Cut-and-Transfer Technique for Ischemic Mitral Regurgitation and Severe Tethering of Mitral Leaflets

Giangiuseppe Cappabianca, MD, Samuele Bichi, MD, Davide Patrini, MD, Pasquale Pellegrino, MD, Camillo Poloni, MD, Elena Perlasca, MD, Marianna Redaelli, MD, and Giampiero Esposito, MD
Department of Cardiac Surgery, "Humanitas Gavazzeni" Hospital, Bergamo, Italy

(Ann Thorac Surg 2013;96:1607–13)



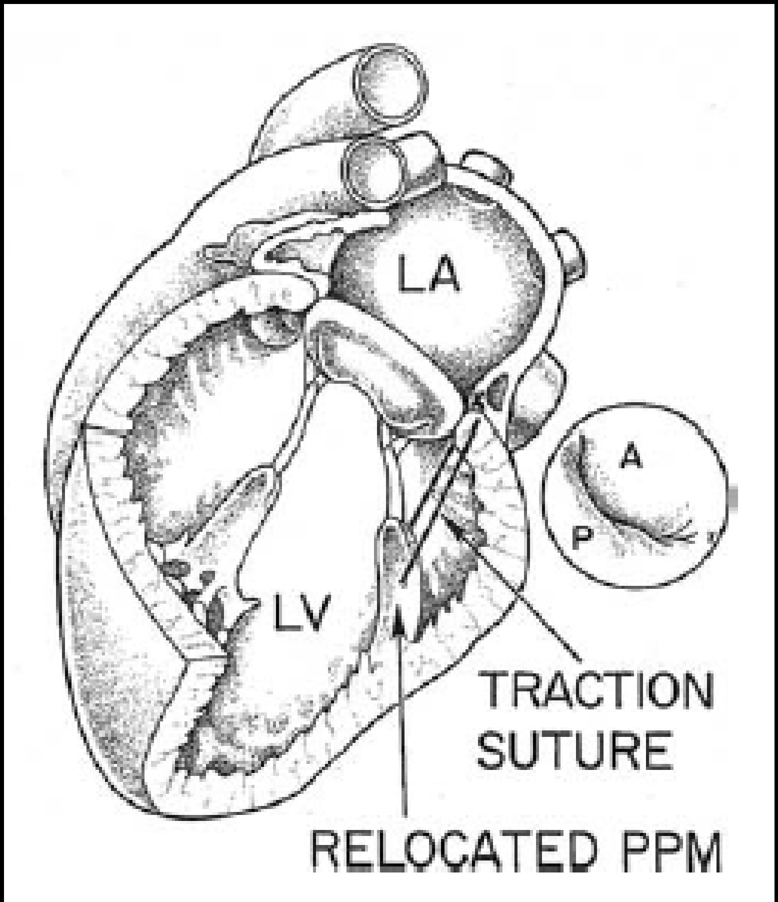


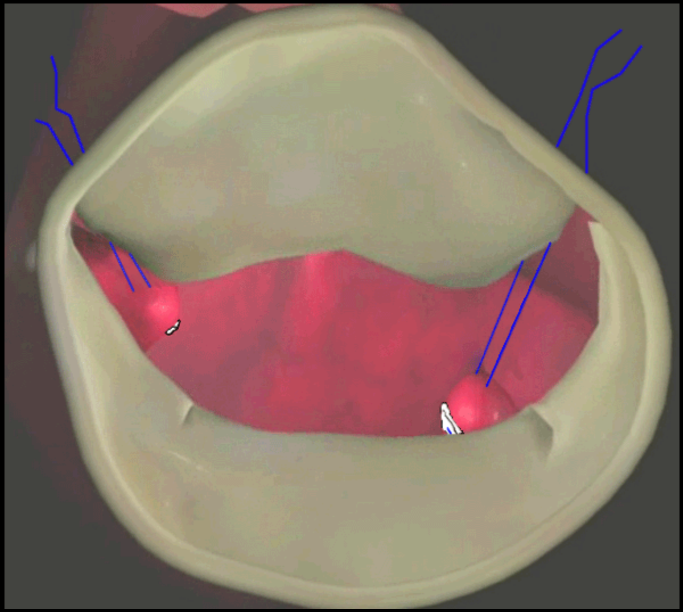
Surgical Relocation of the Posterior Papillary Muscle in Chronic Ischemic Mitral Regurgitation

Irving L. Kron, MD, G. Randall Green, MD, and Jeffrey T. Cope, MD

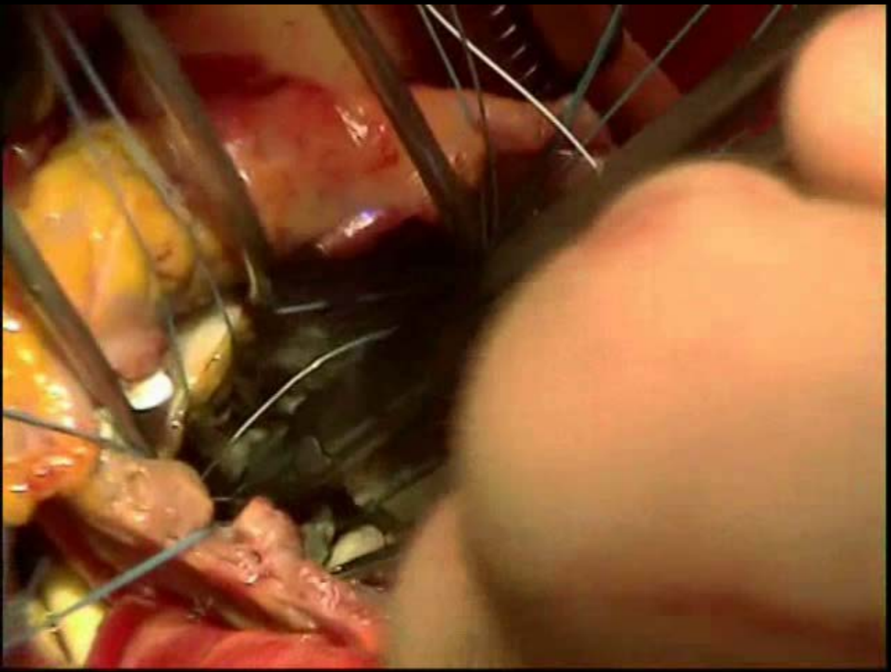
Department of Thoracic and Cardiovascular Surgery, University of Virginia, Charlottesville, Virginia

(Ann Thorac Surg 2002;74:600–1)

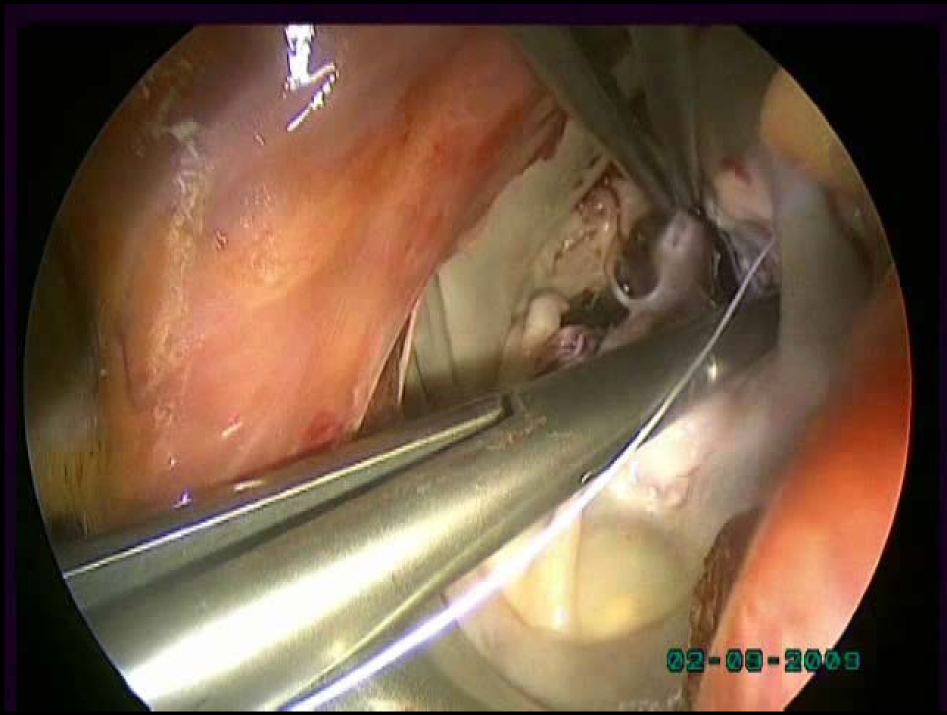




Surgical techniques



Anterior PPM relocation

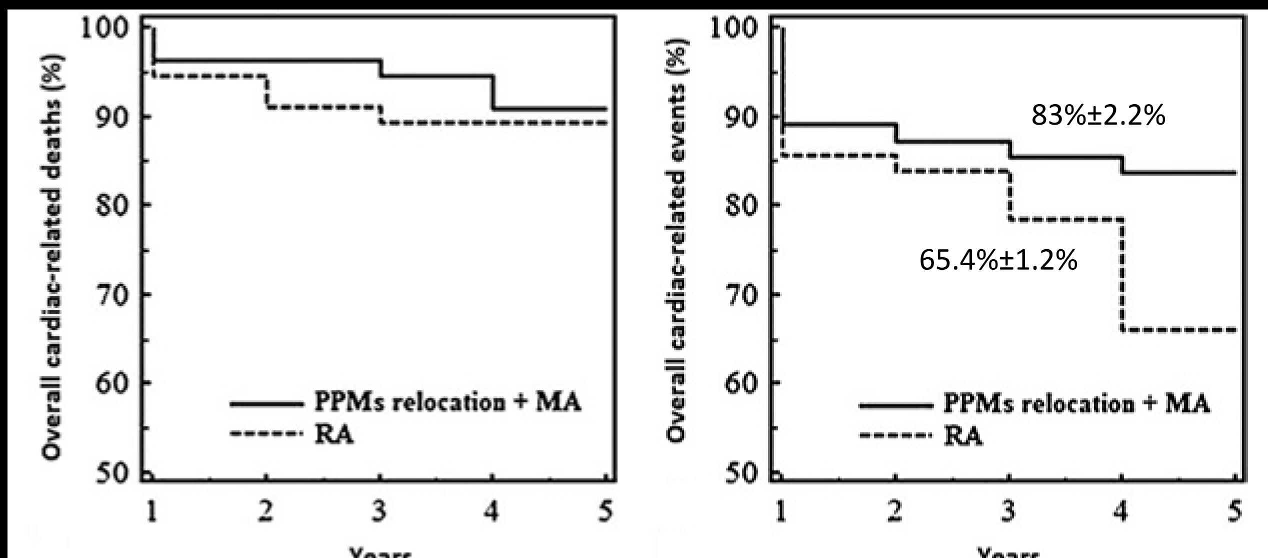


Posterior PPM relocation

Papillary muscle relocation in conjunction with valve annuloplasty improve repair results in severe ischemic mitral regurgitation

Khalil Fattouch, MD, PhD,[a] Patrizio Lancellotti, MD, PhD,[b] Sebastiano Castrovinci, MD,[a] Giacomo Murana, MD,[a] Roberta Sampognaro, MD,[c] Egle Corrado, MD,[d] Marco Caruso, MD, PhD,[d] Giuseppe Speziale, MD,[c] Salvatore Novo, MD,[d] and Giovanni Ruvolo, MD[a]

(J Thorac Cardiovasc Surg 2012;143:1352-5)



Recurrent MR more than moderate occurred in 2.8% vs 11.5% in relocation vs isolated restrictive annuloplasty group, respectively.

Papillary muscle relocation and mitral annuloplasty in ischemic mitral valve regurgitation: Midterm results

Khalil Fattouch, MD, PhD,[a] Sebastiano Castrovinci, MD,[b] Giacomo Murana, MD,[b] Pietro Dioguardi, MD,[a] Francesco Guccione, MD,[a] Giuseppe Nasso, MD,[c] and Giuseppe Speziale, MD[c]

(J Thorac Cardiovasc Surg 2014;148:1947-50)

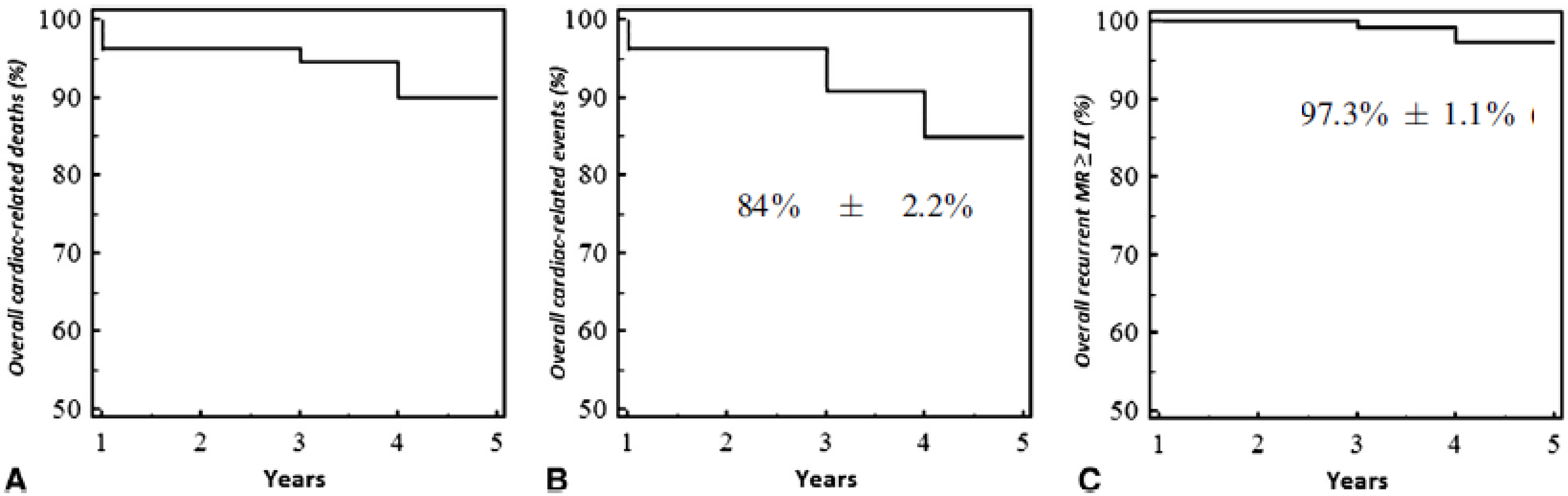


FIGURE 1. Kaplan–Meier log-rank test used to compare cardiac-related deaths (A), cardiac-related events (B), and recurrent MR grade of 2 or greater. *MR*, Mitral regurgitation.

Papillary muscle relocation and mitral annuloplasty in ischemic mitral valve regurgitation: Midterm results

Khalil Fattouch, MD, PhD,[a] Sebastiano Castrovinci, MD,[b] Giacomo Murana, MD,[b] Pietro Dioguardi, MD,[a] Francesco Guccione, MD,[a] Giuseppe Nasso, MD,[c] and Giuseppe Speziale, MD[c]

(J Thorac Cardiovasc Surg 2014;148:1947-50)

TABLE 3. Comparison of echocardiographic data from preoperative to follow-up

Variable	Preoperative	Follow-up	*P* value
Mean tenting area (cm^2)	3.2 ± 0.9	1.1 ± 0.2	<.001
Mean coaptation depth (cm)	1.3 ± 0.1	0.5 ± 0.2	<.001
LVEDD (mm)	58.8 ± 12	49 ± 5	<.05
LVESD (mm)	48.1 ± 9	39 ± 4	<.05
Mean LVEF%	43 ± 6	49 ± 3	<.05

Values are mean ± standard deviation or number (%). *LVEDD*, Left ventricular end-diastolic diameter; *LVEF*, left ventricular ejection fraction; *LVESD*, left ventricular end-systolic diameter.

Conclusions

1. Severe IMR should be treated during CABG

2. **Ischemic etiology of MR demands a different surgical approach in concomitant to annuloplasty.**

Conclusions

- **Repair procedure is associated with lower operative mortality**

- **Improve repair technique to reduce the incidence of recurrent MR, and to improve reverse LV remodeling that lead to better clinical outcomes.**

- Valve replacement it's not a crime and will be reserved for a small subgroup of patients with severe LV dilatation/dysfunction and poor prognosis.