Department of Cardiac Surgery
GVM Care and Research, Maria Eleonora Hospital
and University of Palermo

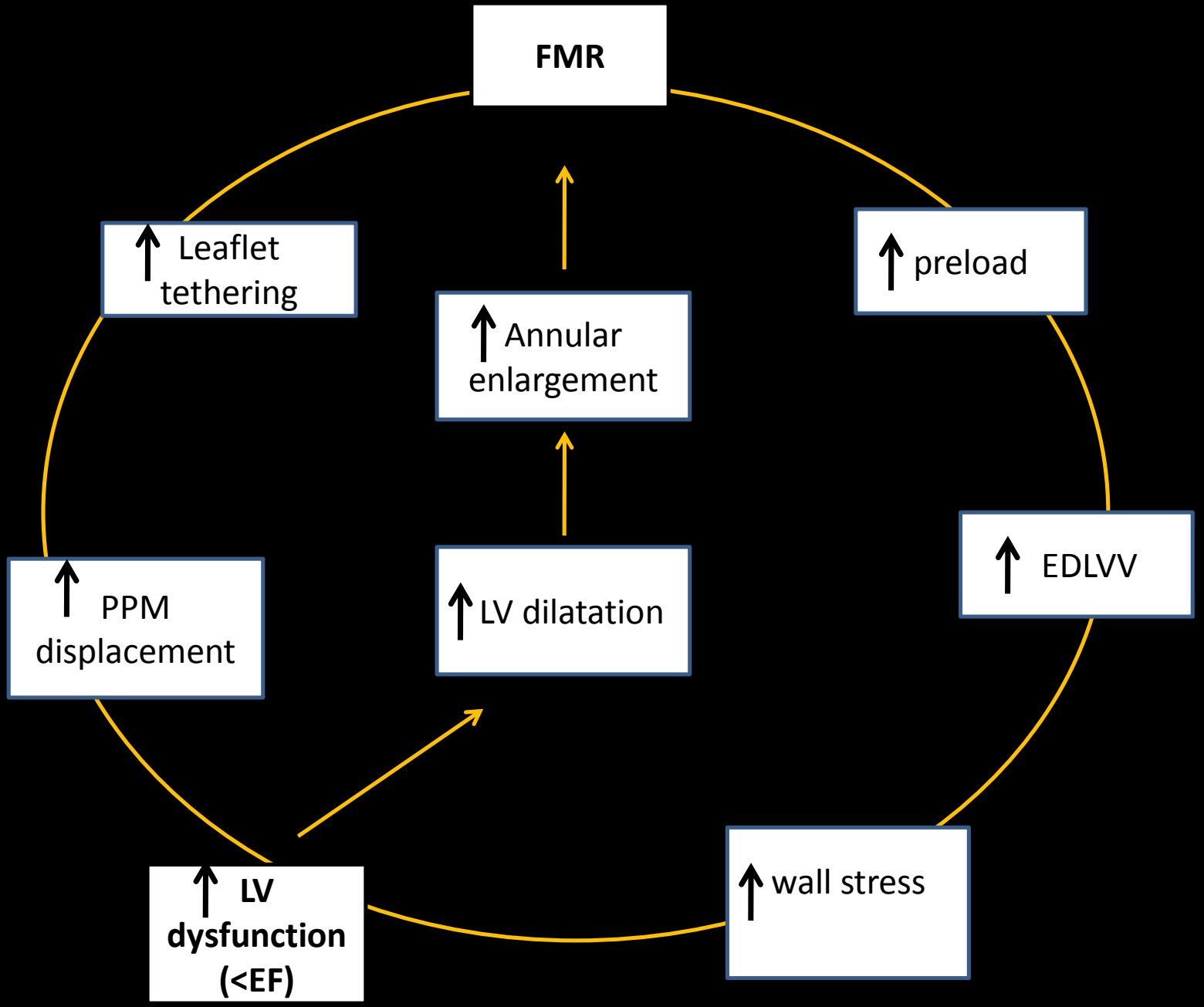
Challenges in the management of secondary mitral regurgitation Moderate or severe

Khalil Fattouch, MD, PhD.

Background

- Chronic secondary MR remains one of the most complex and unresolved aspect in the management of ischemic heart disease

- MR occurs approximately in 20%-25% of patients followed up after MI


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

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, secondary 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

AHA/ACC Guideline

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

(*Circulation*. 2014;129:e521-e643)

WRITING COMMITTEE MEMBERS*

Rick A. Nishimura, MD, MACC, FAHA, Co-Chair†; Catherine M. Otto, MD, FACC, FAHA, Co-Chair†; Robert O. Bonow, MD, MACC, FAHA†; Blase A. Carabello, MD, FACC*†; John P. Erwin III, MD, FACC, FAHA‡; Robert A. Guyton, MD, FACC*§; Patrick T. O'Gara, MD, FACC, FAHA†; Carlos E. Ruiz, MD, PhD, FACC†; Nikolaos J. Skubas, MD, FASE¶; Paul Sorajja, MD, FACC, FAHA#; Thoralf M. Sundt III, MD***††; James D. Thomas, MD, FASE, FACC, FAHA‡‡;

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)***

Moderate Ischemic Mitral Regurgitation To Treat or not to Treat?

1) Does CABG alone correct moderate secondary MR?

2) Does untreated moderate MR have an impact on survival and outcomes after isolated CABG?

Does CABG alone correct moderate IMR?

Revascularization Alone (Without Mitral Valve Repair) Suffices in Patients With Advanced Ischemic Cardiomyopathy and Mild-to-Moderate Mitral Regurgitation

George A. Tolis, Jr, MD, Dimitris P. Korkolis, MD, Gary S. Kopf, MD, and John A. Elefteriades, MD

Section of Cardiothoracic Surgery, Yale University School of Medicine, New Haven, Connecticut

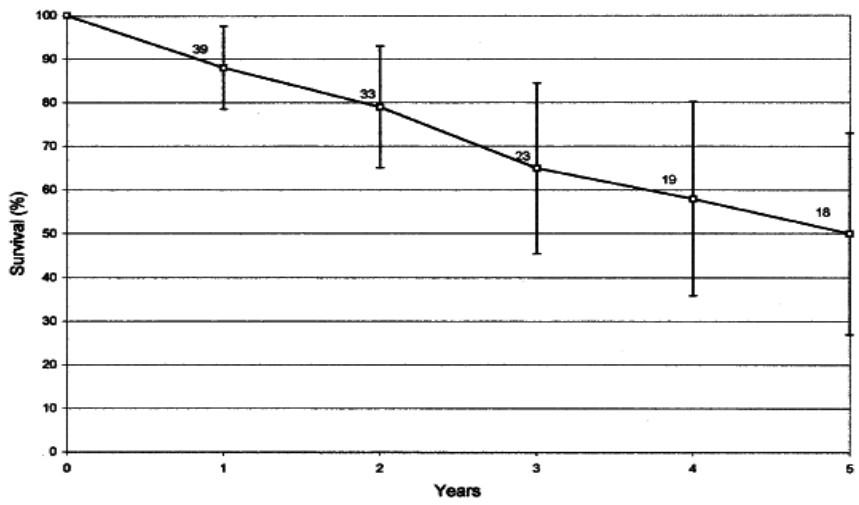
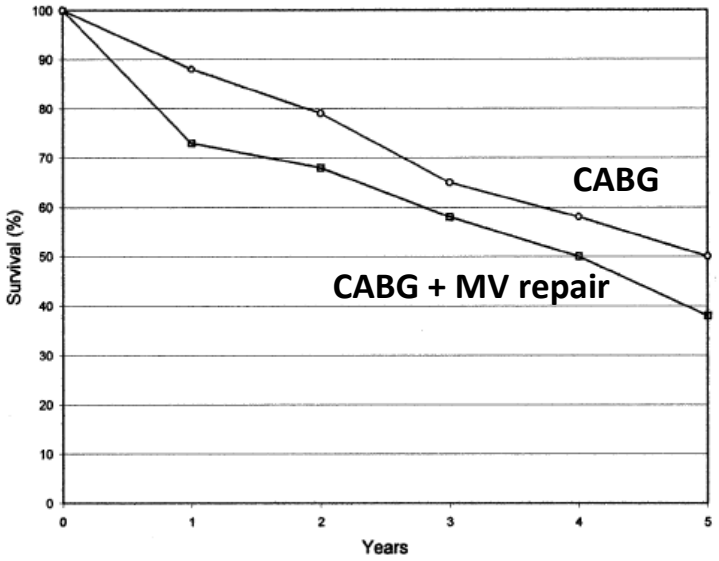


Fig 1. Long-term survival in patients with preoperative mitral regurgitation.



	EF (%)	MR (1–4)	CHF (1–4)
Preoperative	22.0	1.7	3.3
Postoperative	31.5	0.5	1.8

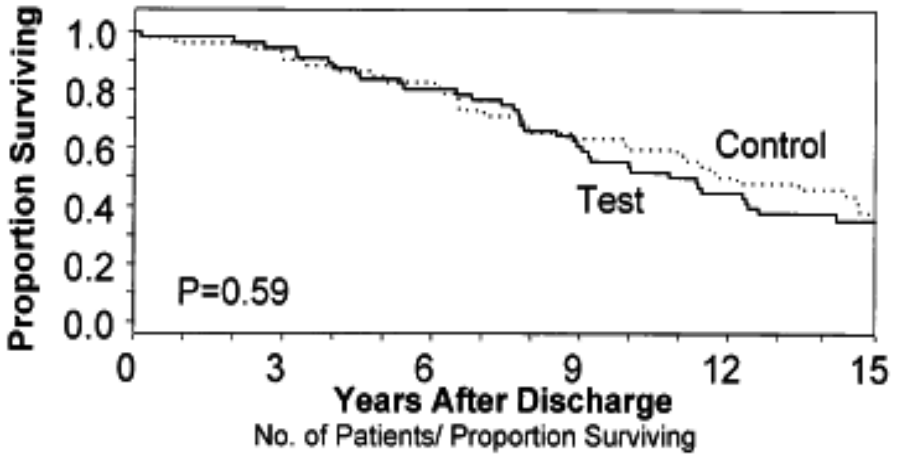
CHF = congestive heart failure; EF = ejection fraction; MR = mitral regurgitation; NYHA = New York Heart Association.

(Ann Thorac Surg 2002;74:1476–81)

CABG GF

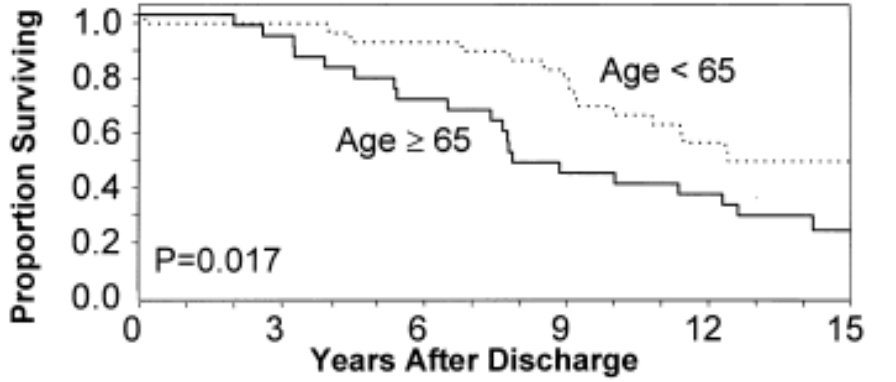
- 49 patie
- FE≤ 30
- CABG p

Does CABG alone correct moderate IMR?



No. of Patients/ Proportion Surviving

Test	56	53/94.6	45/80.4	34/60.7	25/44.6	12/35.0
Control	52	47/90.4	43/82.7	33/63.5	26/50.0	12/37.8

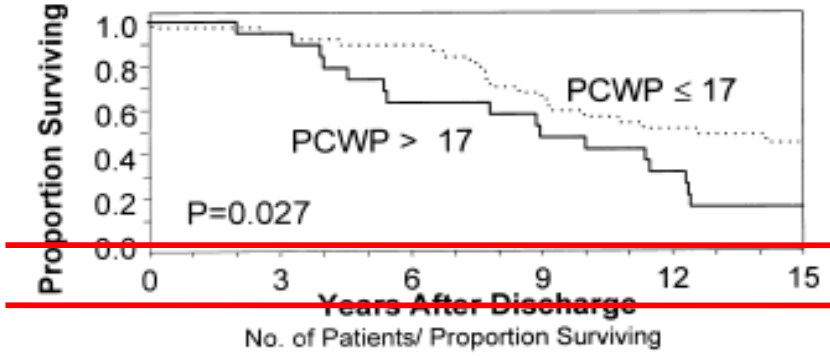


No. of Patients/ Proportion Surviving

Age < 65	30	29/96.7	27/90.0	23/76.7	16/53.3	8/46.7
Age ≥ 65	26	24/92.3	18/69.2	11/42.3	9/34.6	4/21.5

C

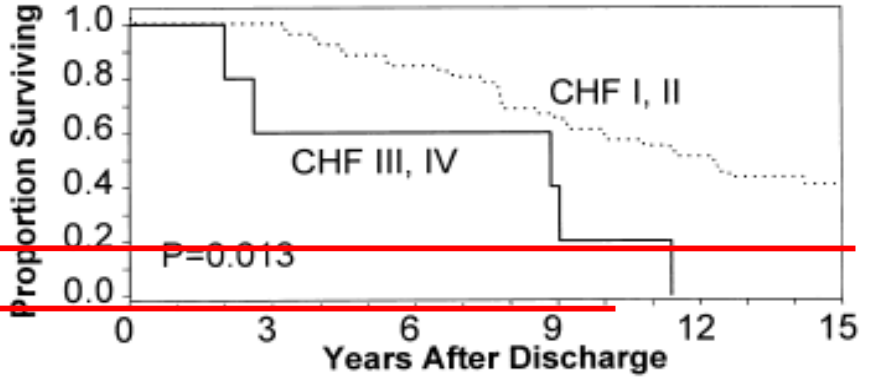
Conclusions: Patients with moderate initial regurgitation



No. of Patients/ Proportion Surviving

CWP ≤ 17	37	35/94.6	33/89.2	25/67.6	19/51.4	10/44.
CWP > 17	19	18/94.7	12/63.2	9/47.4	6/31.6	2/15.8

A



No. of Patients/ Proportion Surviving

CHF I, II	51	50/98.0	42/82.4	32/62.7	25/49.0	12/38.4
CHF III, IV	5	3/60.0	3/60.0	2/40.0		

B

- ❑ Moderate IMR
- ❑ CABG procedure alone
- ❑ No moderate IMR
- ❑ CABG procedure alone

(Ann Thorac Surg 1999;68:426–30)

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

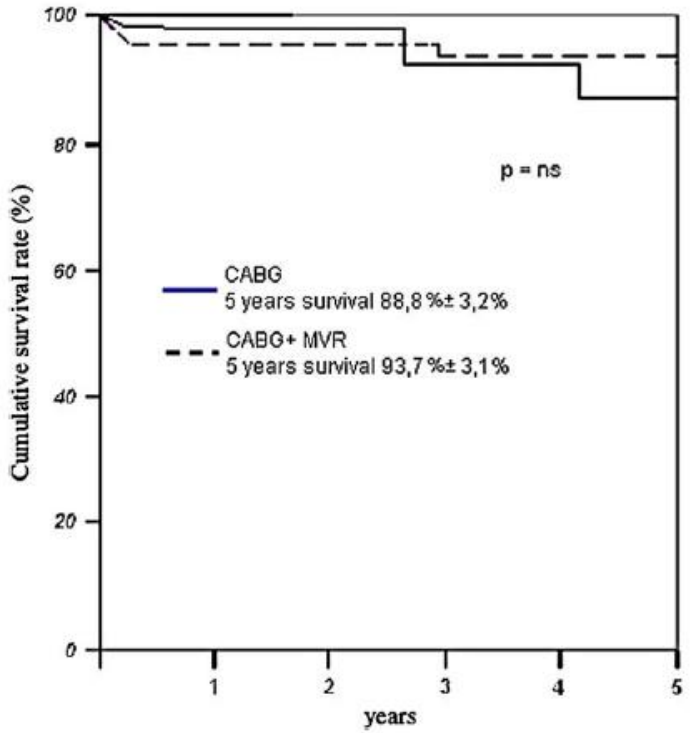


FIGURE 1. Cumulative survival curves for both groups. *CABG*, Coronary artery bypass grafting; *MVR*, mitral valve repair.

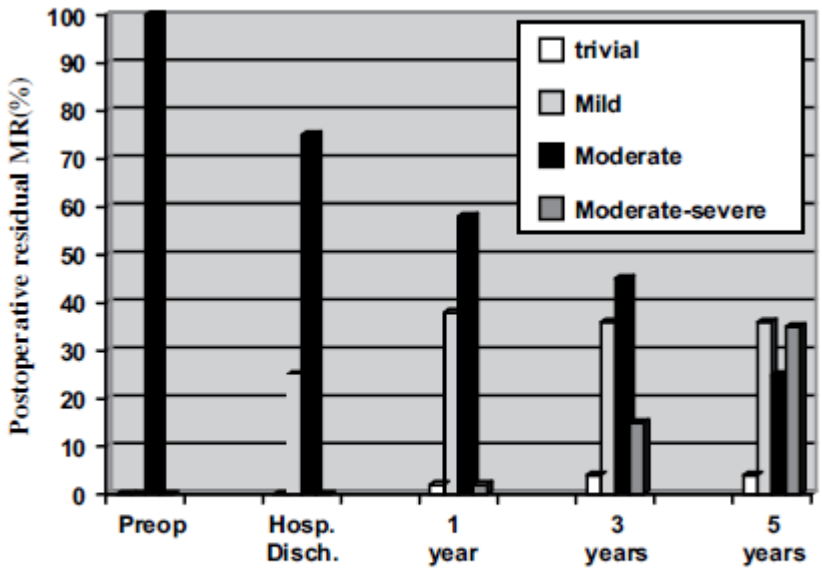


FIGURE 2. Residual postoperative mitral regurgitation *(MR)* in the coronary artery bypass grafting group during follow-up.

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.

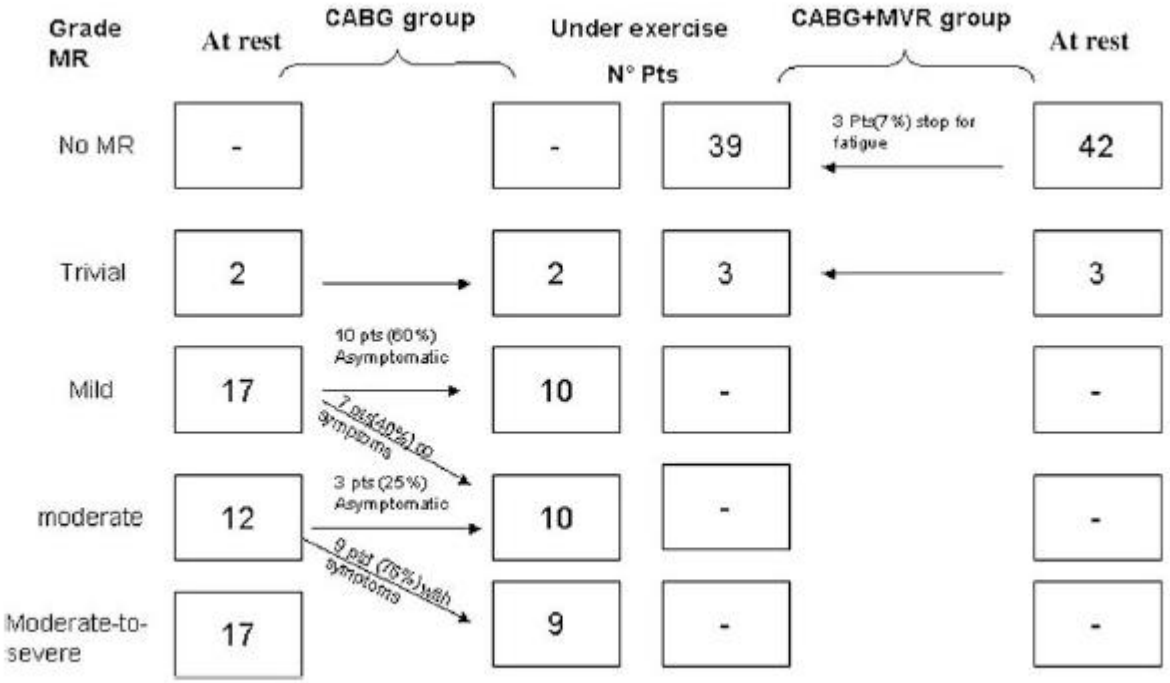


FIGURE 3. Changes in mitral regurgitation *(MR)* grade during stress testing. *CABG*, Coronary artery bypass grafting; *MVR*, mitral valve repair; *Pts*, patients.

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

Improvement with CABG + Mvrepair

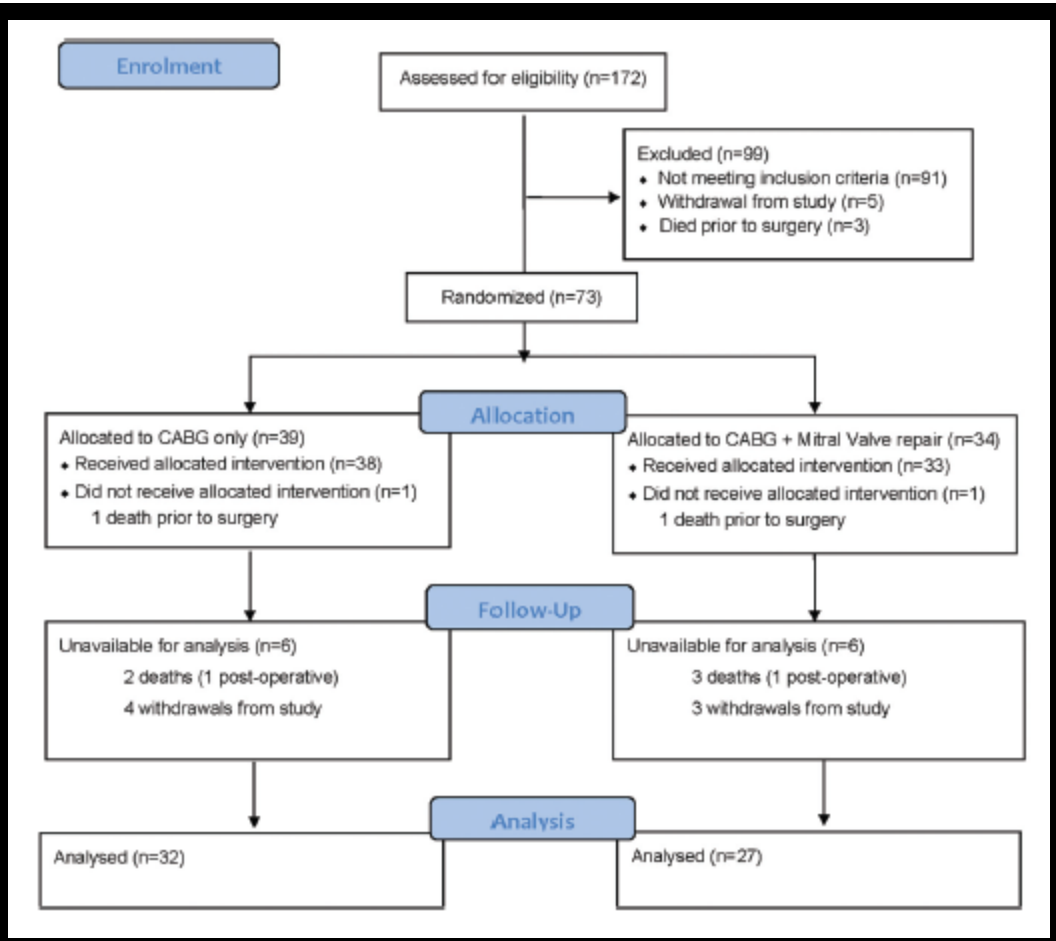
- NYHA (2 grades)
- LVESD (-8 mm vs -2 mm)
- MR grade (at 1 year 1% mod-sev vs 35%)
- No difference in survival

Coronary Artery Bypass Surgery With or Without Mitral Valve Annuloplasty in Moderate Functional Ischemic Mitral Regurgitation

Final Results of the Randomized Ischemic Mitral Evaluation (RIME) Trial

K.M. John Chan, FRCS CTh; Prakash P. Punjabi, FRCS CTh; Marcus Flather, MD, FRCP; Riccardo Wage, DCR (R); Karen Symmonds, DCR (R); Isabelle Roussin, MD; Shelley Rahman-Haley, MD, FRCP; Dudley J. Pennell, MD, FRCP; Philip J. Kilner, MD, PhD; Gilles D. Dreyfus, MD; John R. Pepper, MChir, FRCS; for the RIME Investigators

Clinical Trial Registration—URL: http://www.clinicaltrials.gov. Unique identifier: NCT00413998.
(*Circulation*. 2012;126:2502-2510.)

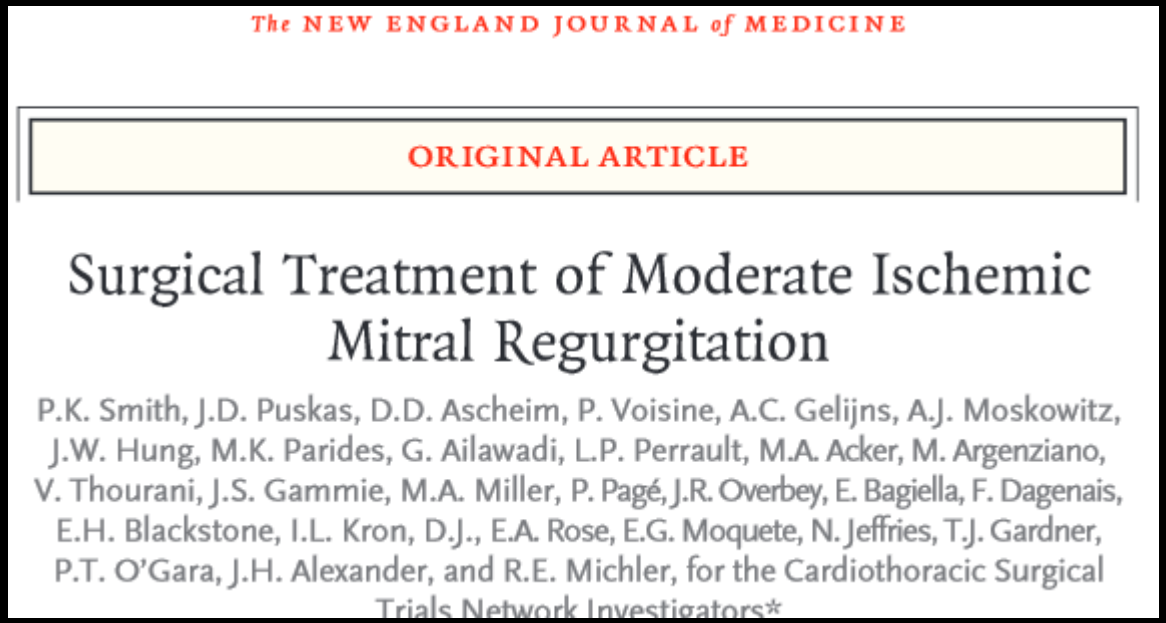


RIME trial Results

End Point	CABG (n=32)		CABG + MVR (n=27)		P-value
	Baseline	% change	Baseline	% change	
Peak VO_2 (ml/kg/min)	15	+ 5	15	+ 23	<0.001
LV ESVI (ml/m^2)	72	- 6	78	- 28	0.002
MR volume (ml/beat)	32	- 29	35	- 80	0.001
BNP (pg/ml)	681	- 58	748	-74	0.003

Improvement with CABG+MVR:

- peak VO2 (20% vs 5%)
- LVESVI (-22mL/m2 vs -4mL/m2)
- MR grade (at 1 year 4% mod-sev vs 50%)
- BNP (75% vs 58%)
- No difference in survival



Patient screened for Moderate IMR
n: 6,676

Randomized patients
n: 301

CABG alone
n: 151

CABG +MVR undersizing ring
n: 150

Exclusion BIAS?!?

Excluded 6.375 pts or 95.5%, p<0.05

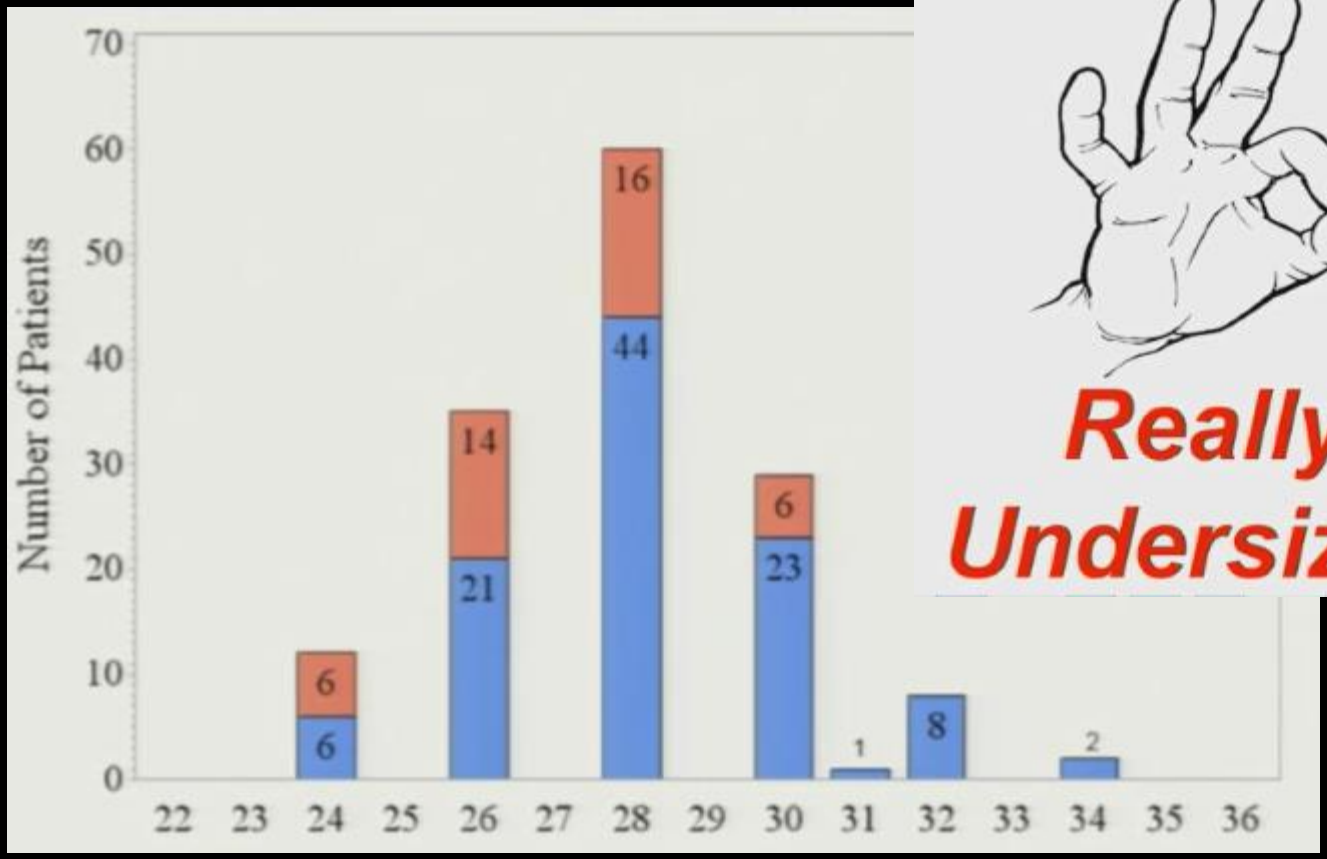
Primary end-point

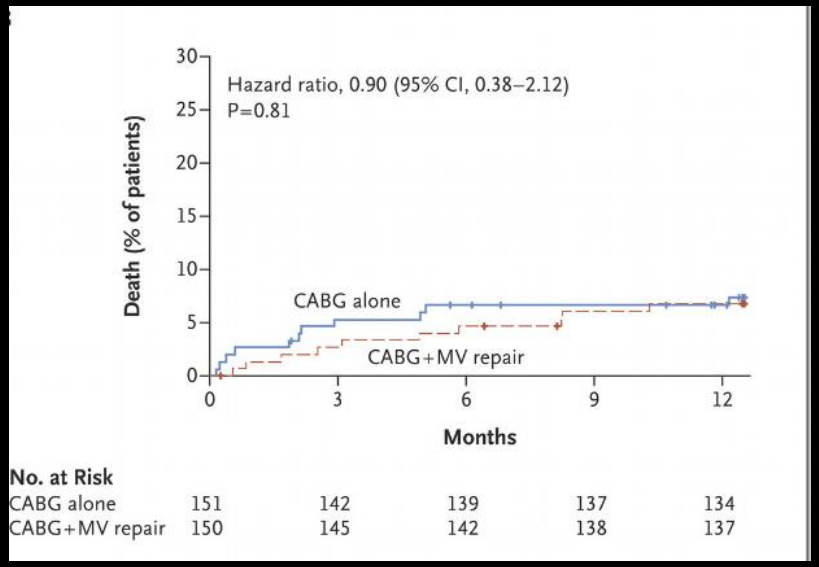
- Degree of left ventricular reverse remodeling as measured by changes in LVESVI

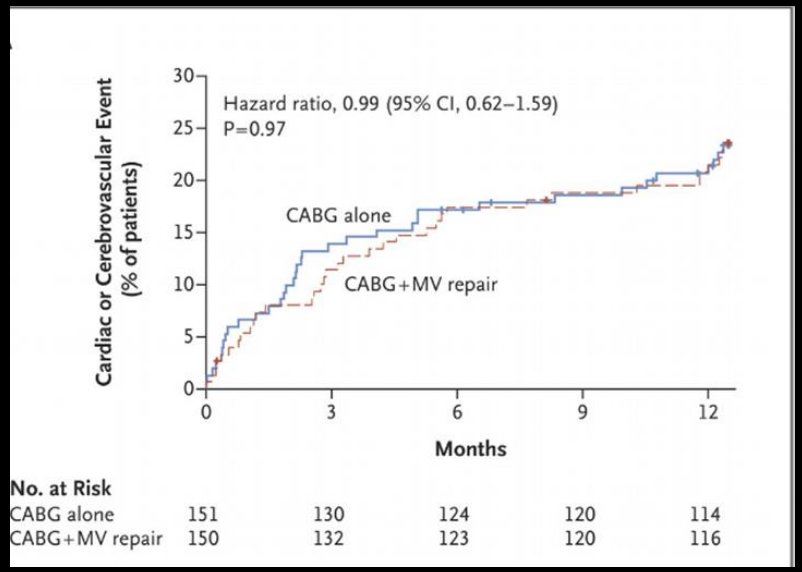
- Powered (90%) to detect a decrease in LVESVI of 12 mL/m2 with repair compared to CABG alone at 12 months

Characteristic	(N=151)	(N=150)
Male sex — no. (%)	99 (65.6)	106 (70.7)
Age — yr	65.2±11.3	64.3±9.6
White race — no. (%)†	122 (80.8)	115 (76.7)
Hispanic ethnic group — no. (%)†	14 (9.3)	12 (8.0)
Medical and surgical history — no./total no. (%)		
Diabetes	66/151 (43.7)	76/150 (50.7)
Renal insufficiency	28/150 (18.7)	24/150 (16.0)
Previous CABG	4/143 (2.8)	4/144 (2.8)
Previous PCI	24/151 (15.9)	26/150 (17.3)
Heart failure	76/151 (50.3)	82/150 (54.7)
Myocardial infarction	97/151 (64.2)	103/150 (68.7)
Atrial fibrillation	35/150 (23.3)	19/149 (12.8)
Implantable cardioverter–defibrillator	6/151 (4.0)	6/150 (4.0)
Stroke	9/151 (6.0)	15/150 (10.0)
Left ventricular end-systolic volume index — ml/m²	54.8±24.9	59.6±25.7
Left ventricular ejection fraction — %	41.2±11.6	39.3±10.9
Effective regurgitant orifice area — cm²	0.2±0.1	0.2±0.1
Grade on CCS angina scale — no./total no. (%)‡		
No angina	45/150 (30.0)	50/149 (33.6)
Class III or IV	51/150 (34.0)	46/149 (30.9)
NYHA class III or IV — no. (%)§	67 (44.4)	55 (36.7)
Minnesota Living with Heart Failure score¶	43.0±27.2	40.4±27.5
Concomitant procedure — no. (%)		
Management of left atrial appendage‖	8 (5.3)	12 (8.0)
Atrial maze procedure	10 (6.6)	11 (7.3)
No. of grafts	3.3±0.9	3.2±0.9
Duration of aortic cross-clamping — min	74.7±36.7	117.2±35.4
Duration of cardiopulmonary bypass — min	106.8±49.7	163.1±54.9

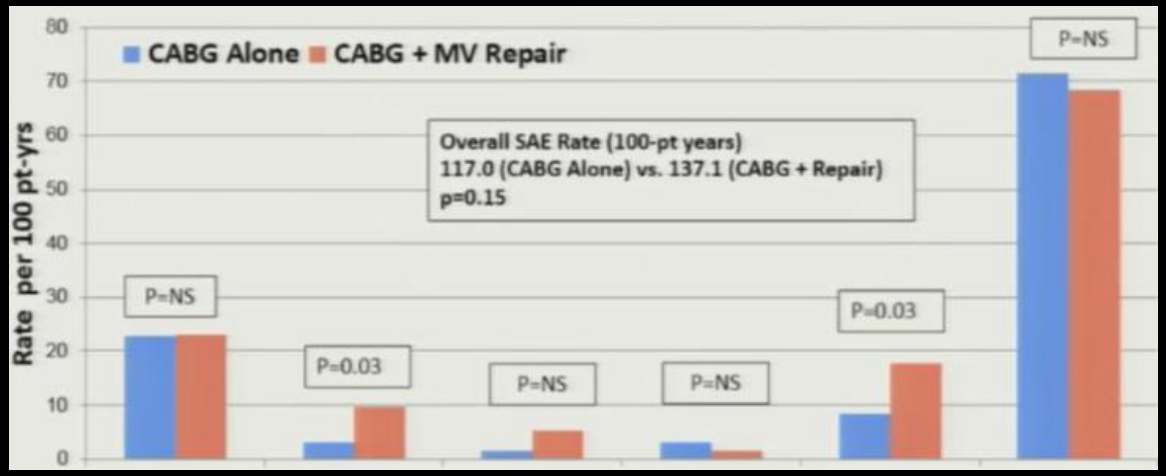
Distribution of ring size for sex



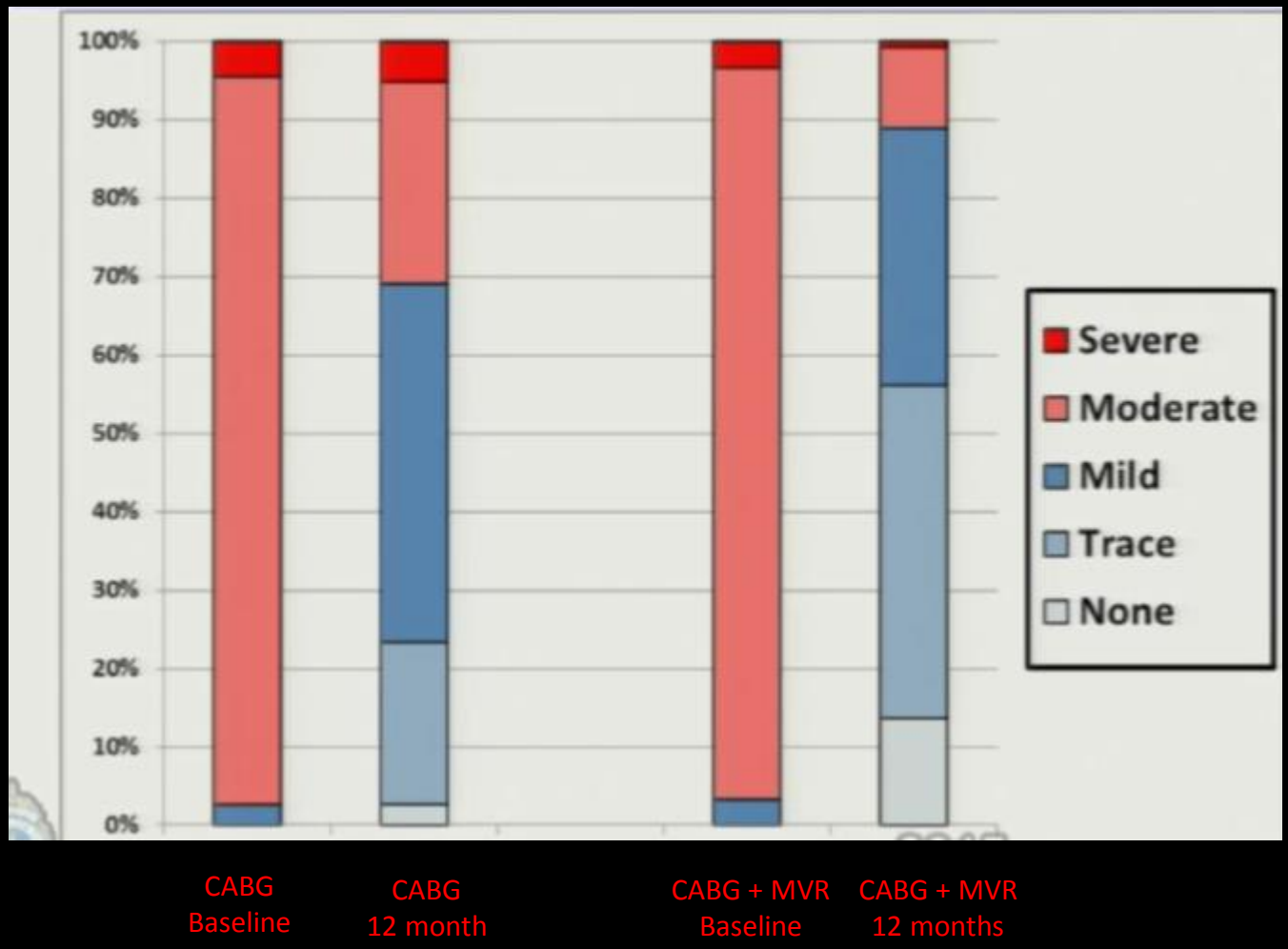




Rates of serious adverse events and re-hospitalization



Mitral Regurgitation



Significant MR at 12 months was 10% for CABG + MVR and 30% for CABG alone !!!!!

Summary

- No difference at 1 year
- In the degree of reverse remodelling
- In mortality
- In MACCE, hospital readmission or QOL

- CABG + MVR associatred with more:
- Neurologic events
- Increased cross clamp CPB time
- Longer ICU hospital stay

- At 1 year higher degree of moderate and severe MR in the CABG alone group

Conclusions

- The trial did not demonstrate a clinically meaningful advantage to the routine addition of MVr to CABG

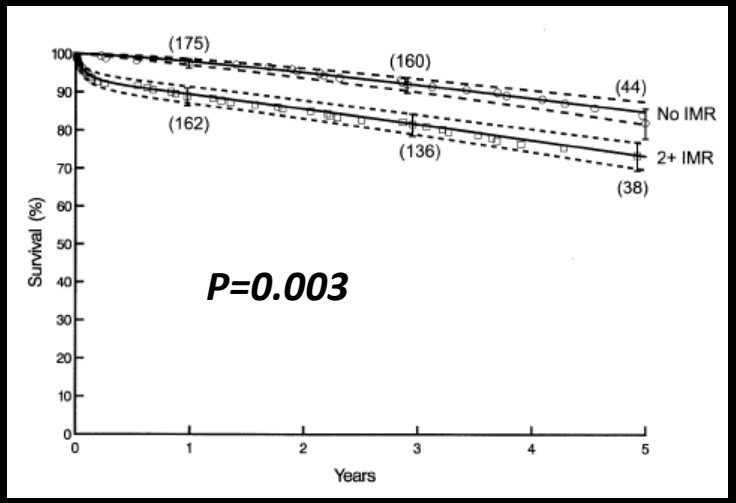
- Longer-term follow-up is ongoing to evaluate if the lower incidence of mod/sev MR at 1-Year translate into a net clinicla benefit for patients undergoing CABG + MVR

Does CABG alone correct moderate IMR?

Importance of Moderate Ischemic Mitral Regurgitation

B-Khanh Lam, MD, A. Marc Gillinov, MD, Eugene H. Blackstone, MD, Jeevanantham Rajeswaran, MS, Bertram Yuh, BS, Sunil K. Bhudia, MD, Patrick M. McCarthy, MD, and Delos M. Cosgrove, MD

Departments of Thoracic and Cardiovascular Surgery, and Biostatistics and Epidemiology, The Cleveland Clinic Foundation, Cleveland, Ohio



Conclusions. Moderate ischemic mitral regurgitation does not reliably resolve with CABG surgery alone and is associated with reduced survival. Therefore, a mitral valve procedure may be warranted for such patients presenting for CABG. A randomized trial comparing strategies of revascularization with mitral valve repair and revascularization alone is required to determine optimal treatment.

Moderate IMR GROUP

- **467** patients
- Moderate IMR
- 77% left ventricular disfunction
- CABG alone

Control GROUP

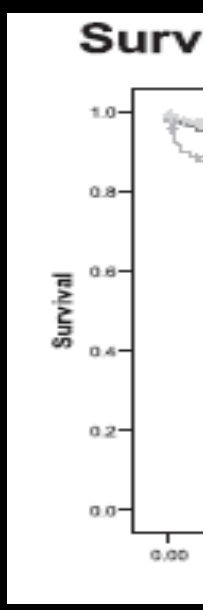
- 2097 patients
- No IMR
- CABG procedure alone

(Ann Thorac Surg 2005;79:462–70)

Does residual moderate IMR have an impact on survival and functional status?

Impact of Moderate Functional Mitral Insufficiency in Patients Undergoing Surgical Revascularization

Eugene A. Grossi, MD; Gregory A. Crooke, MD; Paul L. DiGiorgi, MD; Charles F. Schwartz, MD; Ulrich Jorde, MD; Robert M. Applebaum, MD; Greg H. Ribakove, MD; Aubrey C. Galloway, MD; Juan B. Grau, MD; Stephen B. Colvin, MD



Conclusions

In all patients undergoing isolated CABG without severe MR, the presence of moderate MR, and even mild MR, is associated with decreased survival. This association is independent of the severity of LV dysfunction and the numerous comorbidities seen in this patient cohort. Furthermore, no association was found between the amount of coronary artery disease and the outcomes in these patients. However, it remains unknown whether MV repair at the time of CABG will improve the survival of patients with mild or moderate MR or alter the unfavorable natural history of this disease.

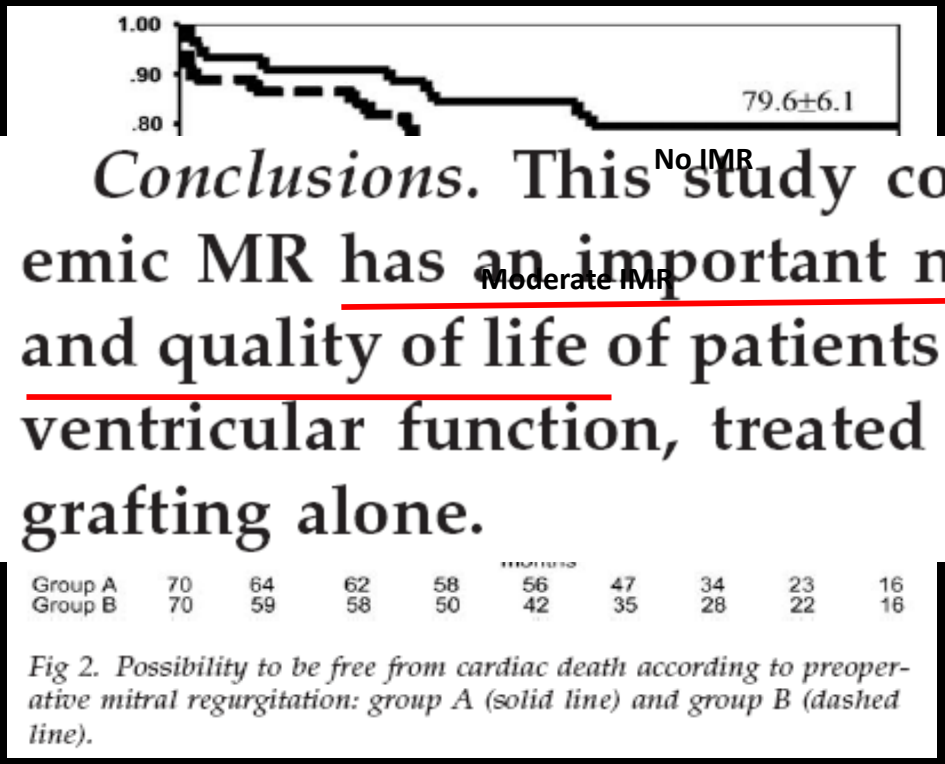
(*Circulation*. 2006;114[suppl I]:I-573–I-576.)

Does residual moderate IMR have an impact on survival and functional status?

Impact of No-to-Moderate Mitral Regurgitation on Late Results After Isolated Coronary Artery Bypass Grafting in Patients With Ischemic Cardiomyopathy

Michele Di Mauro, MD, Gabriele Di Giammarco, MD, Giuseppe Vitolla, MD, Marco Contini, MD, Angela L. Iacò, MD, Antonio Bivona, MD, Luca Weltert, MD, and Antonio M Calafiore, MD

Division of Cardiac Surgery, University "G. D'Annunzio," Chieti, and Division of Cardiac Surgery, European Hospital, Rome, Italy



Conclusions. This study co
emic MR has an important n
and quality of life of patients
ventricular function, treated
grafting alone.

Fig 2. Possibility to be free from cardiac death according to preoperative mitral regurgitation: group A (solid line) and group B (dashed line).

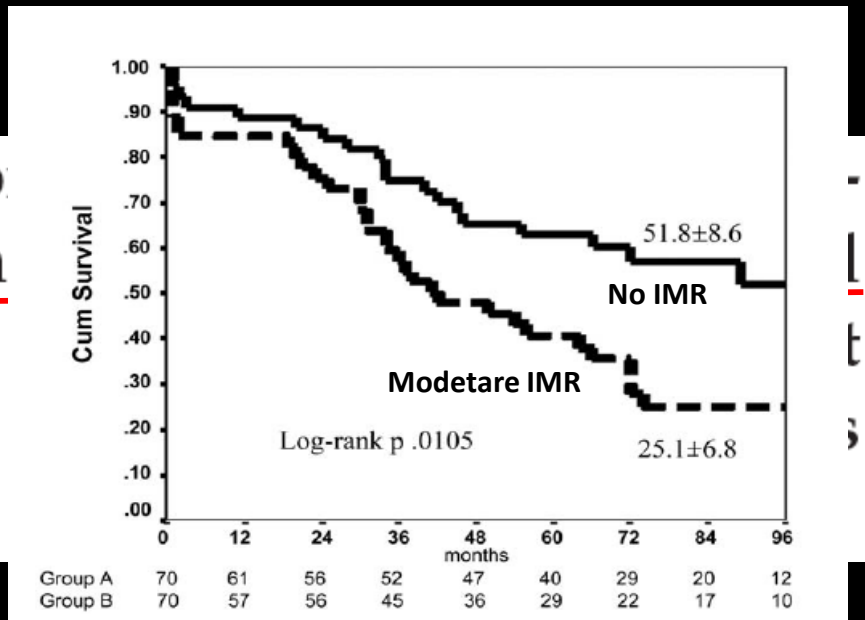


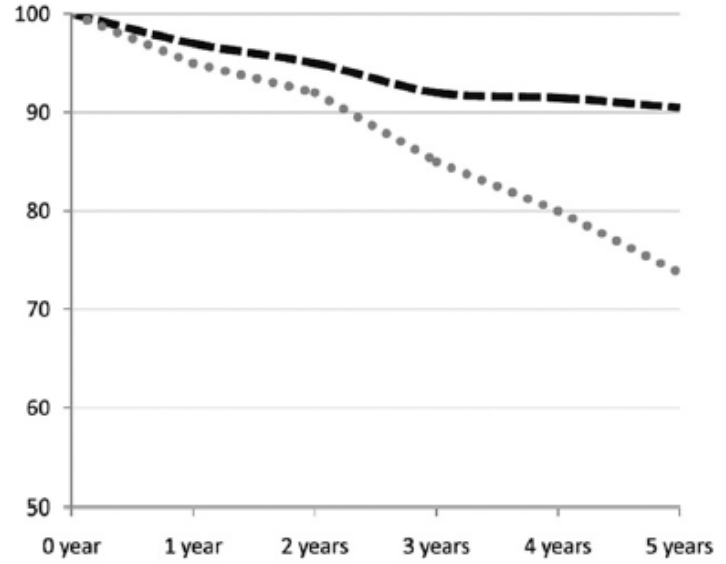
Fig 5. Possibility to be free from death and New York Heart Association class III or IV according to preoperative mitral regurgitation: group A (solid line) and group B (dashed line).

(Ann Thorac Surg 2006;81:2128–34)

Impact of Moderate Ischemic Mitral Regurgitation After Isolated Coronary Artery Bypass Grafting

Khalil Fattouch, MD, PhD, Roberta Sampognaro, MD, Giuseppe Speziale, MD, Massimo Salardino, MD, Giuseppina Novo, MD, Marco Caruso, MD,

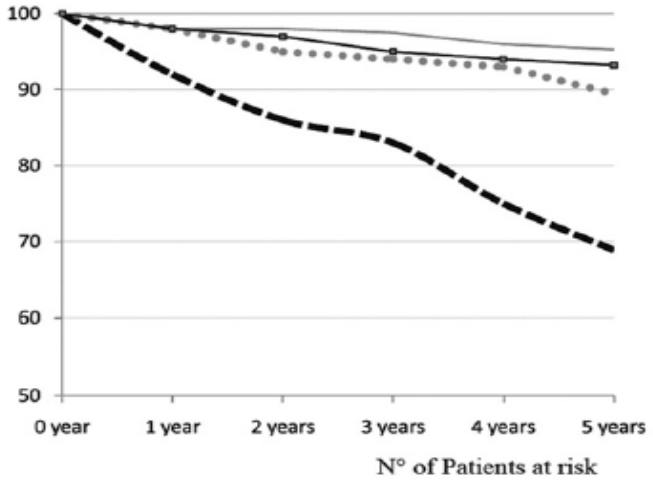
(Ann Thorac Surg 2010;90:1187–94)



N° of patients at Risk

No IMR:	344	336	321	309	298
Moderate IMR:	161	148	144	138	125

Fig 1. Overall survival rate (± SE) according to the presence of moderate ischemic mitral regurgitation (IMR). Five-year survival rate for patients without IMR (dashed line) versus patients with moderate IMR (dotted line) was 90.5% ± 1.8% versus 73.7% ± 2.1%, respectively ($p < 0.001$).



N° of Patients at risk

IMR and EF≤40%:	70	65	58	55	40
IMR and EF>40%:	95	91	89	85	82
No IMR and EF>40%:	226	218	211	205	193
No IMR and EF≤40%:	118	110	102	100	96

Fig 3. Freedom from cardiac-related death in all patients with moderate ischemic mitral regurgitation (IMR) and patients without ischemic mitral regurgitation according to the ejection fraction (EF). Five-year freedom from cardiac-related death was 68.9% ± 2.8% for patients with moderate IMR and EF 40% or less (dashed line; $p < 0.0001$), 89.5% ± 3.1% for patients with moderate IMR and EF greater than 40% (dotted line), 93.2% ± 1.8% for patients without IMR and EF 40% or less (square line), and 95.3% ± 1.2% for patients without IMR and EF greater than 40% (solid line).

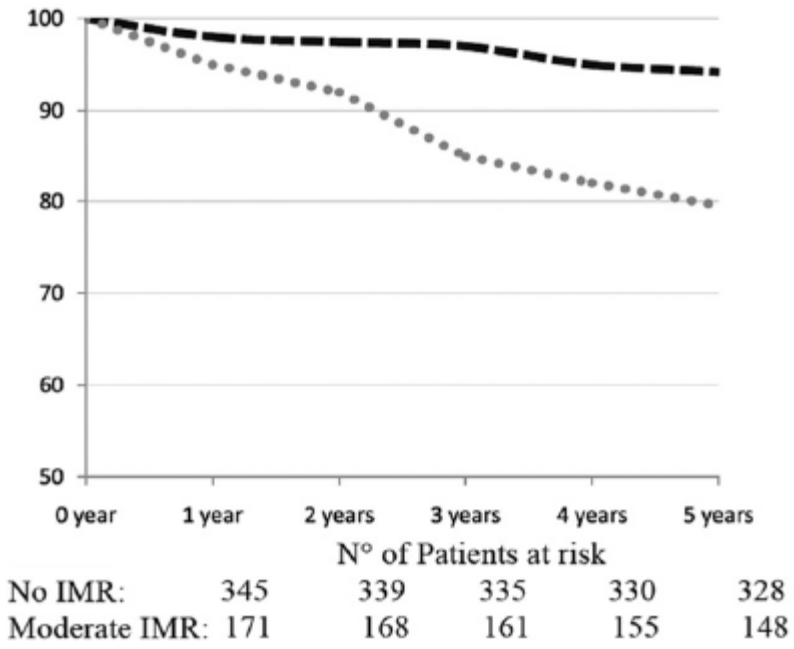


Fig 2. Freedom from cardiac-related death according to presence of moderate ischemic mitral regurgitation (IMR). Five-year freedom from cardiac-related death in group of patients without IMR (dashed line) versus patients with moderate IMR (dotted line) was 94.2% ± 1.6% versus 79.5% ± 1.5%, respectively ($p < 0.001$).

Table 2. Predictors for Late Mortality[a] in All Population by Cox Regression

Predictor	*p* Value	Hazard Ratio	95% CI
Age	0.0002	11	5.6–98
NYHA class III or higher	0.004	9.0	1.9–40
LVEF 40% or less	0.01	13	1.6–50
Renal failure	0.01	12	1.7–90
Ischemic mitral regurgitation	0.007	2.7	1.5–4.8

[a]Late and overall mortality were calculated using Cox regression, and outcomes are presented as hazard ratios.

CI = confidence interval; LVEF = left ventricular ejection fraction; NYHA functional class = New York Heart Association.

Does CABG alone cure moderate IMR?

- Fattouch trial doesn't cure MR in 35%
- RIME trial doesn't cure MR in 50%
- CTS trial doesn't cure MR in 30%

… Presence of moderate MR decrease long term survival

…no differences in terms of mortality and MACCE!!!

Surgical management of moderate ischemic mitral valve regurgitation: Where do we stand?

Khalil Fattouch, Sebastiano Castrovinci, Giacomo Murana, Marco Moscarelli, Giuseppe Speziale

World J Cardiol 2014 November 26; 6(11): 1218-1222

I prefer to do an error of commission instead an error of ommission

Graig Miller

27 **Chan KM**, Punjabi PP, Flather M, Wage R, Symmonds K, Roussin I, Rahman-Haley S, Pennell DJ, Kilner PJ, Dreyfus GD, Pepper JR. Coronary artery bypass surgery with or without mitral valve annuloplasty in moderate functional ischemic mitral regurgitation: final results of the Randomized Ischemic Mitral Evaluation (RIME) trial. *Circulation* 2012; **126**: 2502-2510 [PMID: 23136163 DOI: 10.1161/CIRCULATIONAHA.112.143818]

28 **Wierup P**, Egeblad H, Nielsen SL, Scherstén H, Kimblad PO, Bech-Hansen O, Roijer A, Nilsson F, McCarthy PM, Bouchard D, Jacobsen J, Johnsen SP, Poulsen SH, Mølgaard H. Moderate mitral regurgitation in patients undergoing CABG--the MoMIC trial. *Scand Cardiovasc J* 2009; **43**: 50-56 [PMID: 18850485 DOI: 10.1080/14017430802430950]

29 **Smith PK**, Michler RE, Woo YJ, Alexander JH, Puskas JD, Parides MK, Hahn RT, Williams JB, Dent JM, Ferguson TB, Moquete E, Rose EA, Pagé P, Jeffries NO, O'Gara PT, Ascheim DD. Design, rationale, and initiation of the Surgical Interventions for Moderate Ischemic Mitral Regurgitation Trial: a report from the Cardiothoracic Surgical Trials Network. *J Thorac Cardiovasc Surg* 2012; **143**: 111-117, 117.e1 [PMID: 21788032 DOI: 10.1016/j.jtcvs.2011.05.006]

Severe Secondary MR

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 symptomatic patients with severe MR, LVEF <30%, option for revascularization, and evidence of viability	IIa	C

AHA/ACC Guideline

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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)***

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

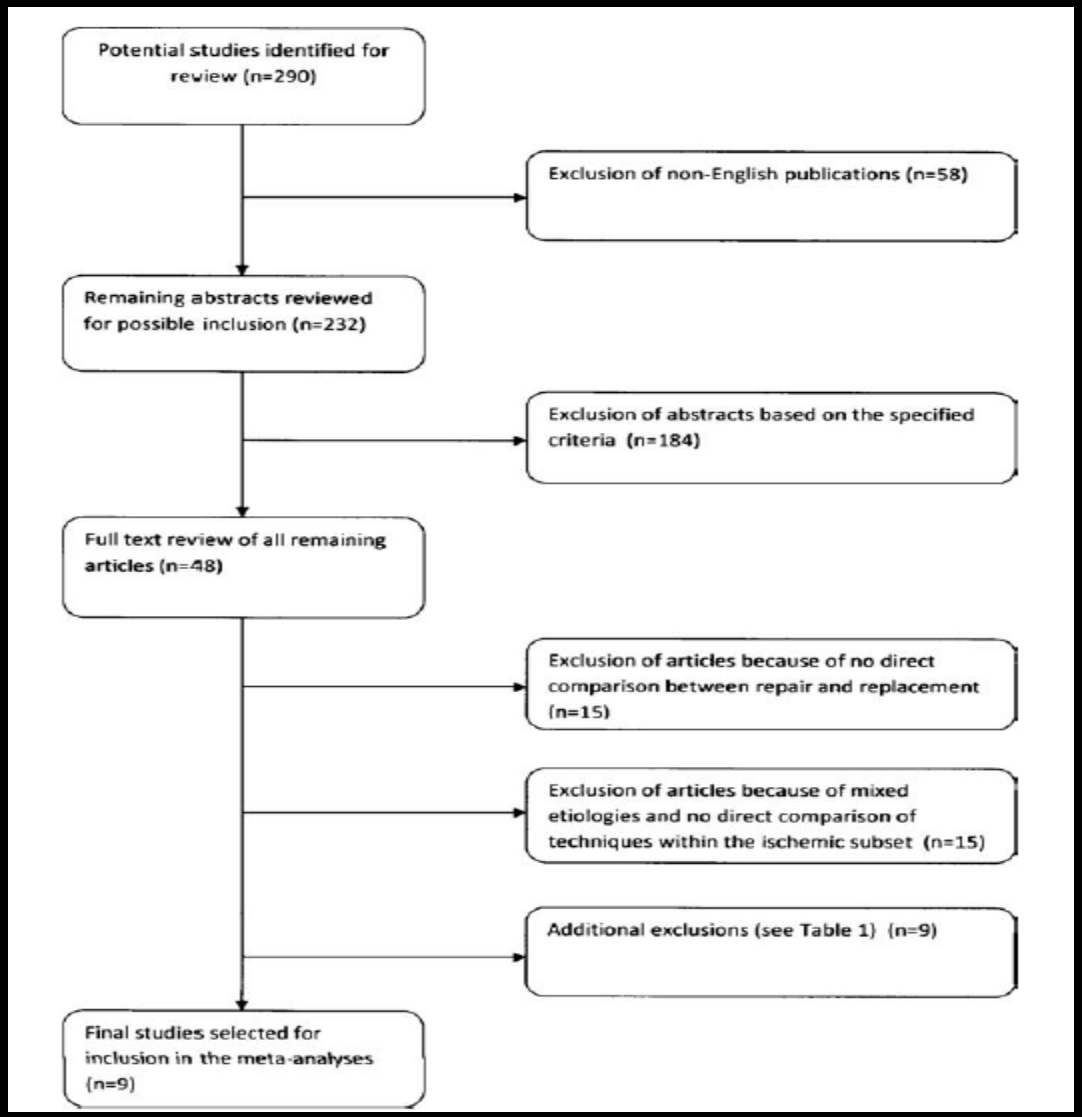
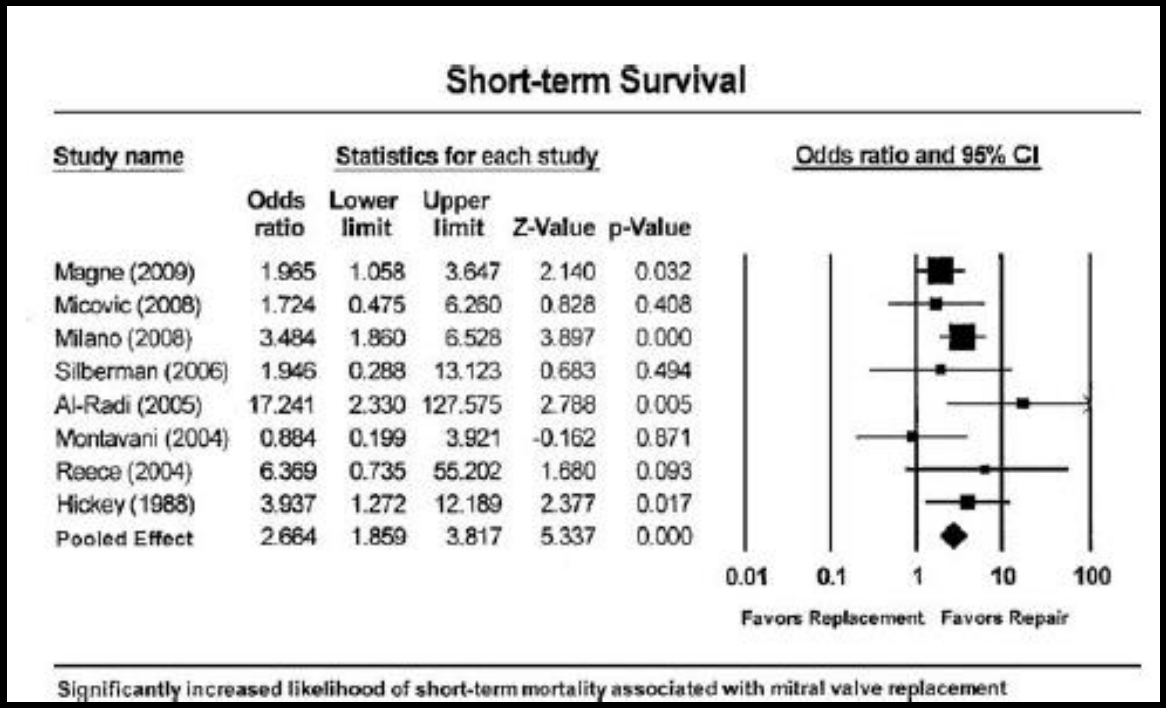
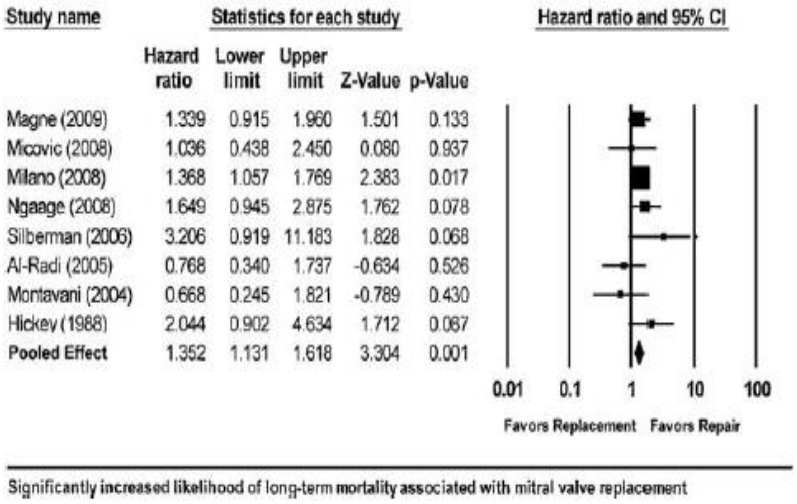


Table 1. Rationale for exclusion of selected publications.

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



Long-term Survival



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

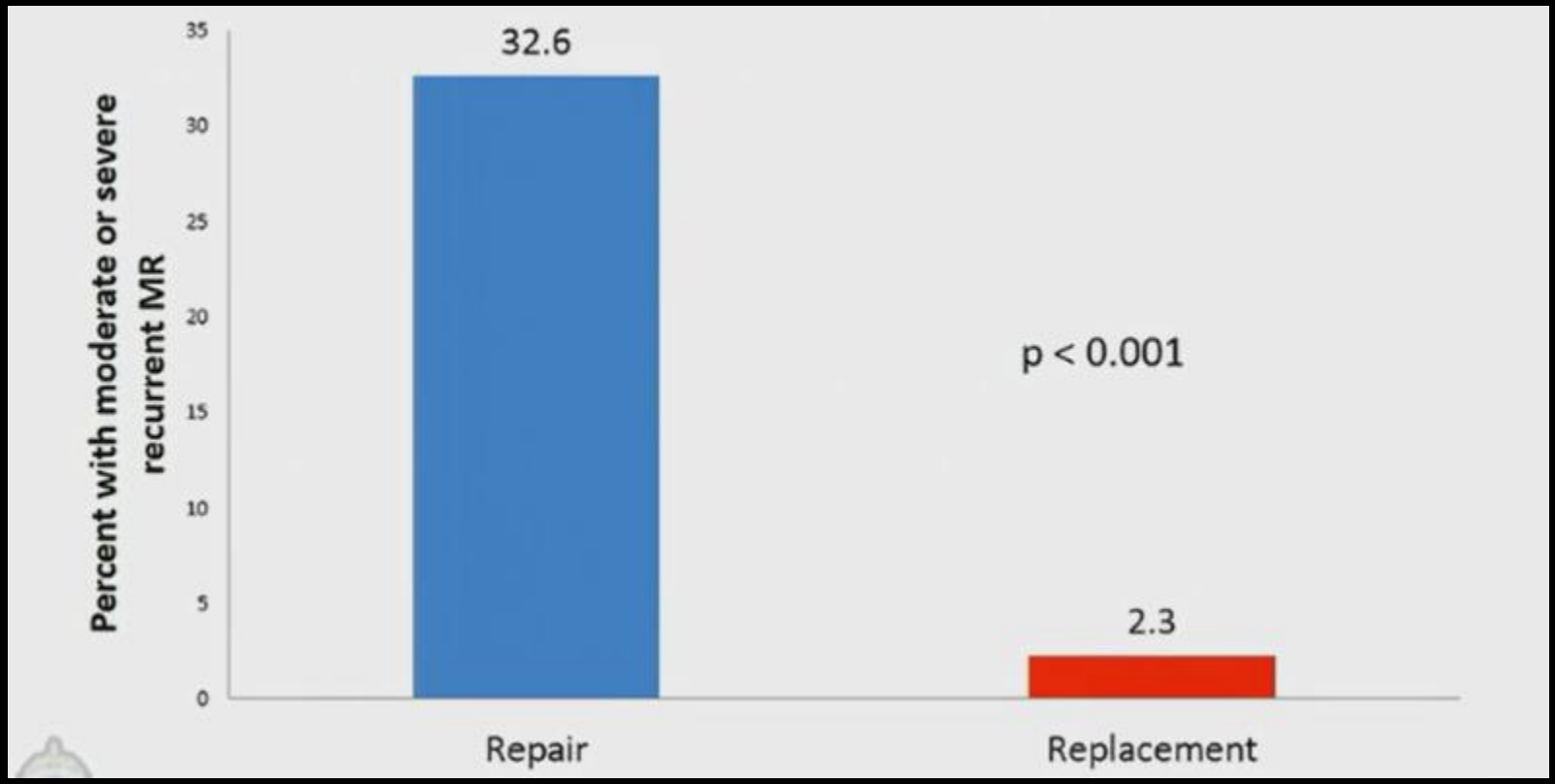
Mitral-Valve Repair versus Replacement for Severe Ischemic Mitral Regurgitation

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*

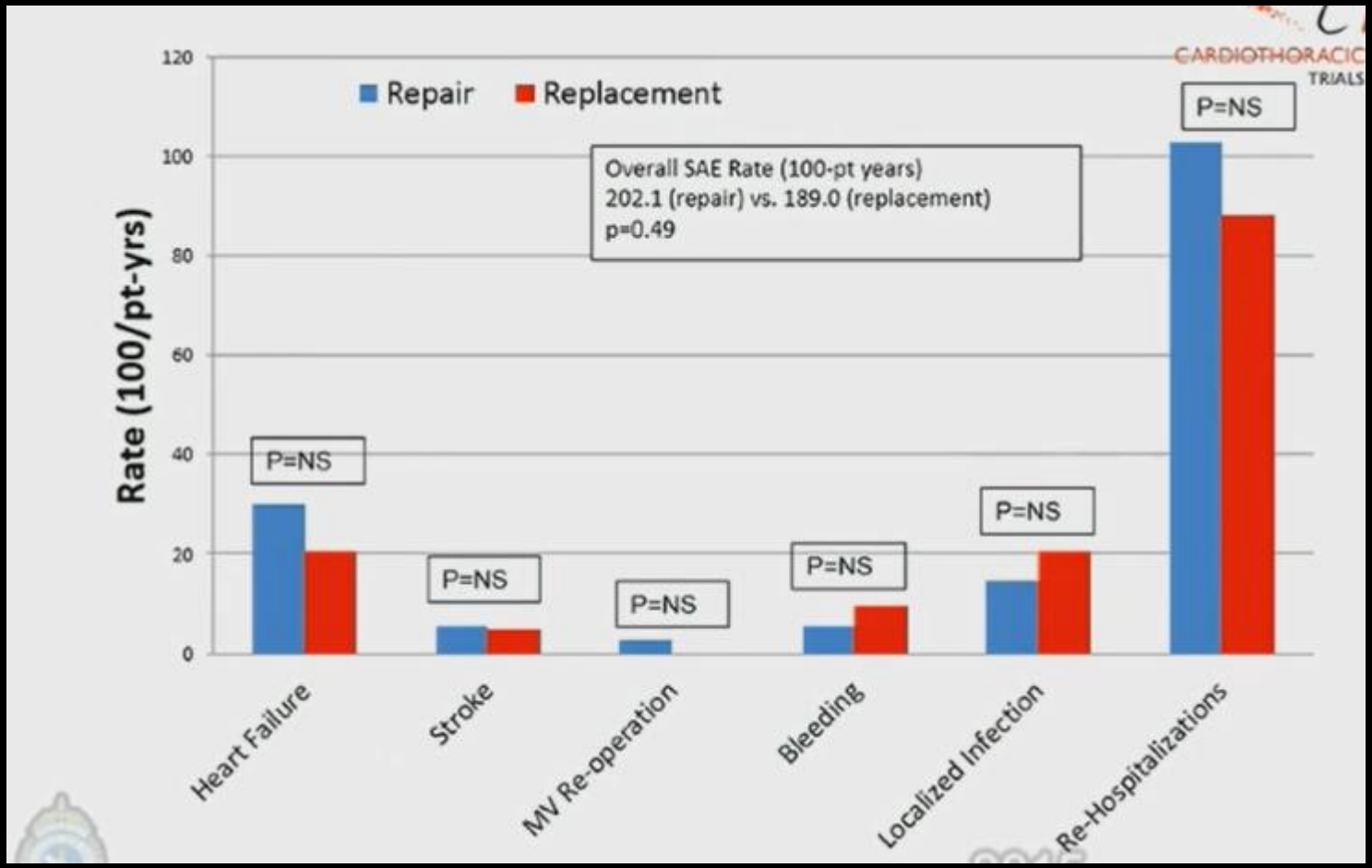
Is MV repair better than replacement for severe IMR?

- Does it result in improved survival? Early or late?
- Does it result in decreased complications?
- Does it result in more LV reverse remodeling?
- Does it result in improved freedom from hospitalizations or symptoms of heart failure?
- Is it a more reliable operation for long term freedom from recurrent MR?

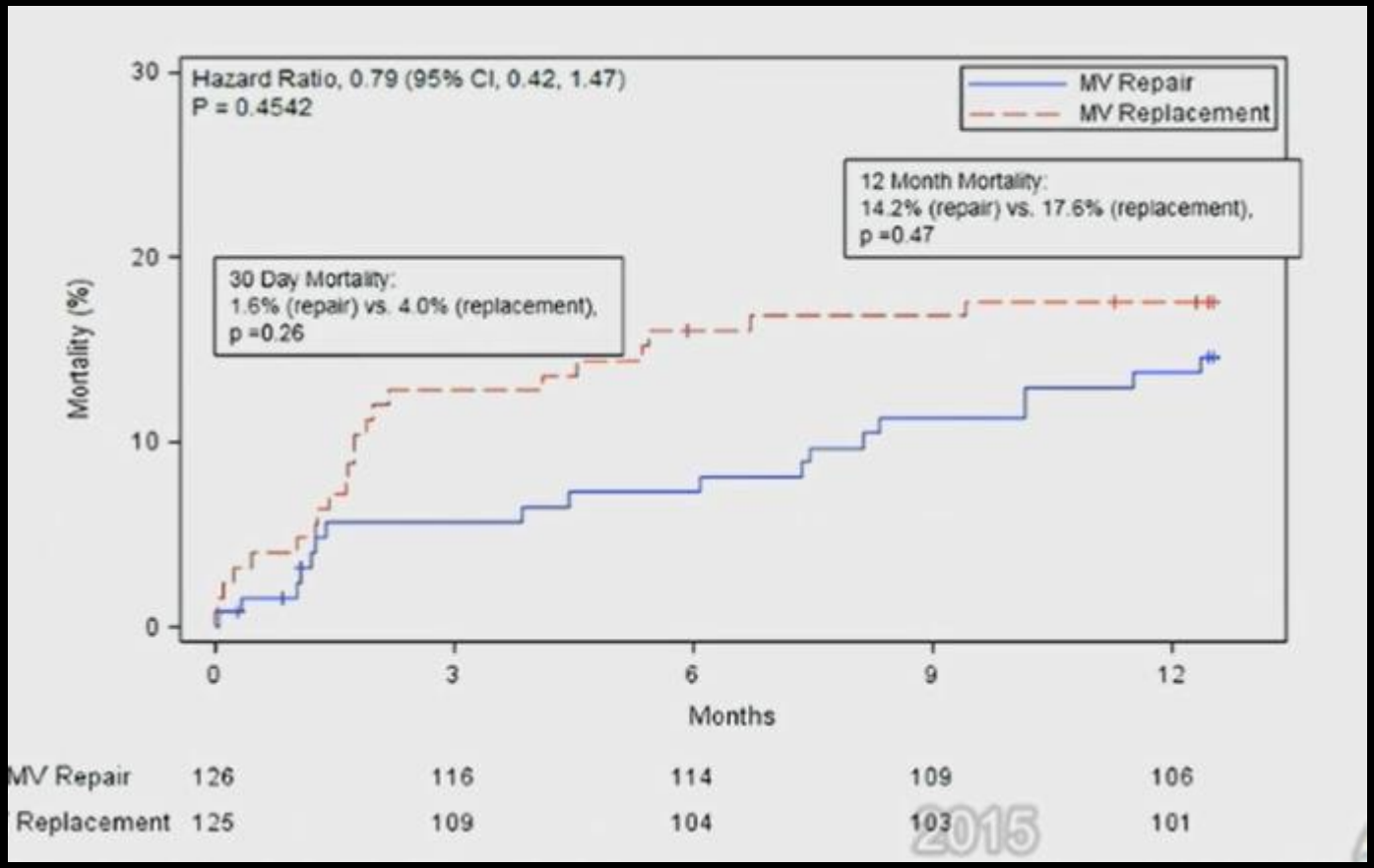
Recurrent moderate to severe MR at 1 year



Serious Adverse Events



Mortality


Hazard Ratio, 0.79 (95% CI, 0.42, 1.47)
P = 0.4542
MV Repair
MV Replacement
12 Month Mortality:
14.2% (repair) vs. 17.6% (replacement),
p =0.47
30 Day Mortality:
1.6% (repair) vs. 4.0% (replacement),
p =0.26
Mortality (%)
30
20
10
0
0
3
6
9
12
Months
MV Repair 126 116 114 109 106
Replacement 125 109 104 103 101
2015

Severe IMR

THE NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

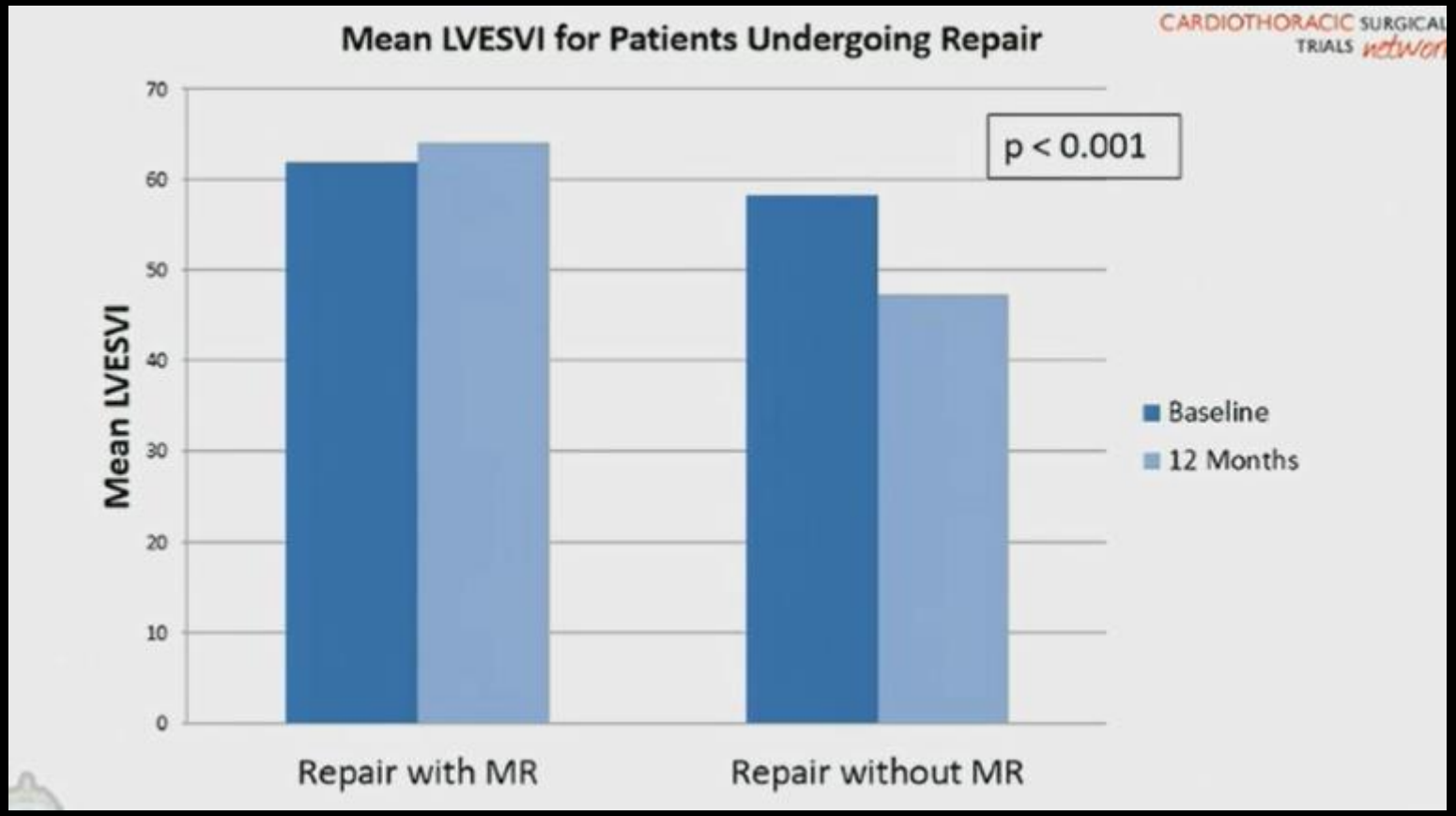
Mitral-Valve Repair versus Replacement for Severe Ischemic Mitral Regurgitation

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*

CABG + MV repair vs replacement

LVESI (size/remodeling)	same
Mortality	same
CV events	same
Functional status	same

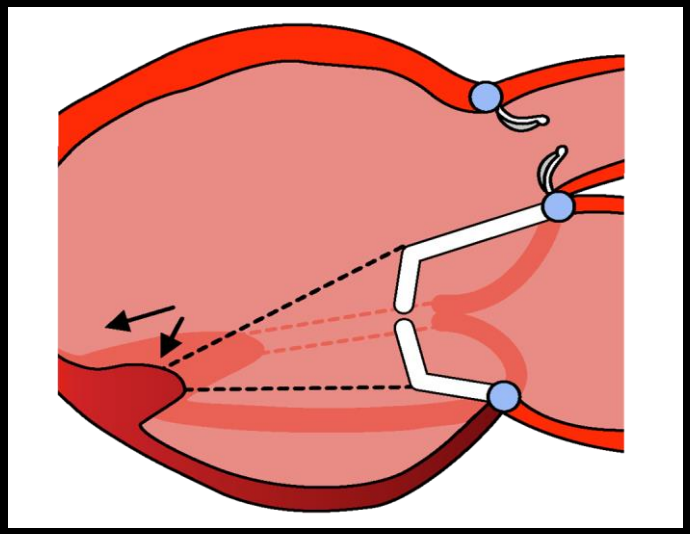
LVESVI with recurrent MR



What we do since today?

Mitral Valve annuloplasty doesn’t mean mitral valve repair

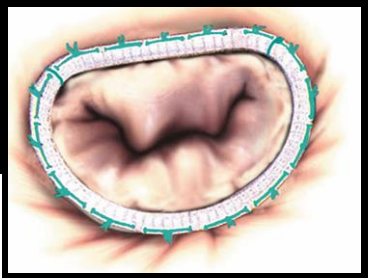
The "RING and RUN" approach
Undersizing annuloplasty for all cases?

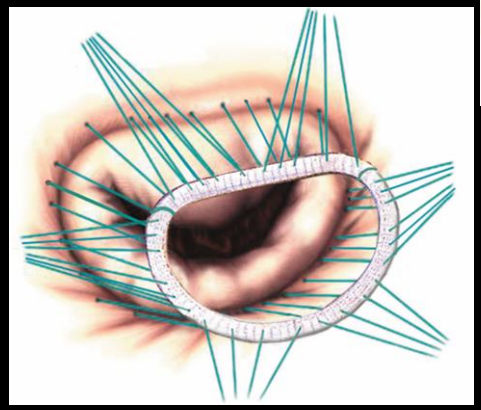


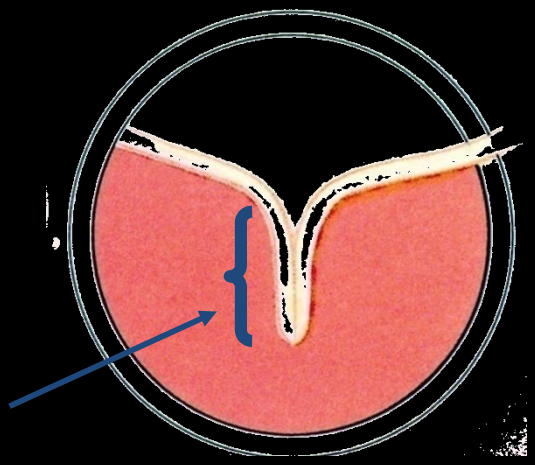
AN ANNULAR SOLUTION TO

A VENTRICULAR PROBLEM

?







Coaptation Reserve
> = 8 mm

1-year recurrence of mr after undersized annuloplasty in FMR is up to 20%

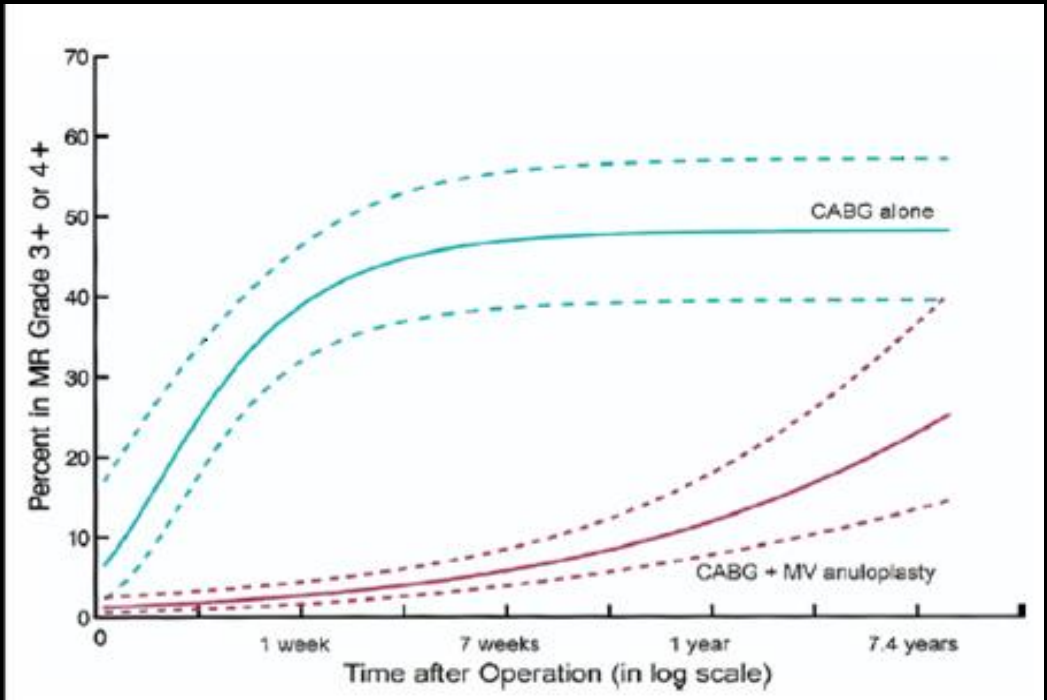


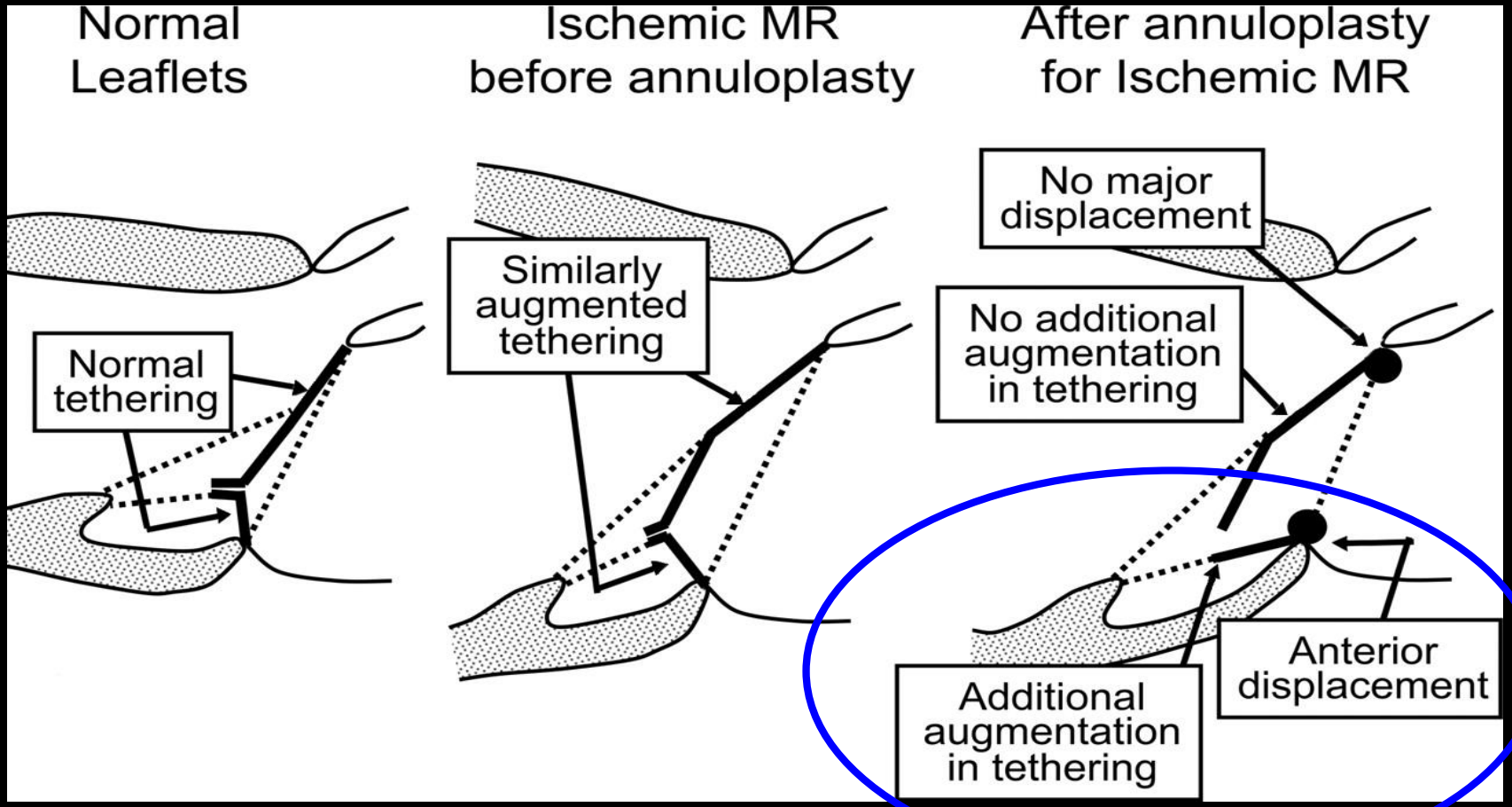
Figure 2 Proportion of Patients in MR Grades 3+ or 4+

- **Early**
  Increased posterior leaflet tethering
- **Late**
  Ongoing LV remodeling "The moving target"

  Insufficient coaptation reserve

T. Mihalievic et al. JACC 2007;49:2191-201

Mecchanism of recurrent MR after annuloplasty



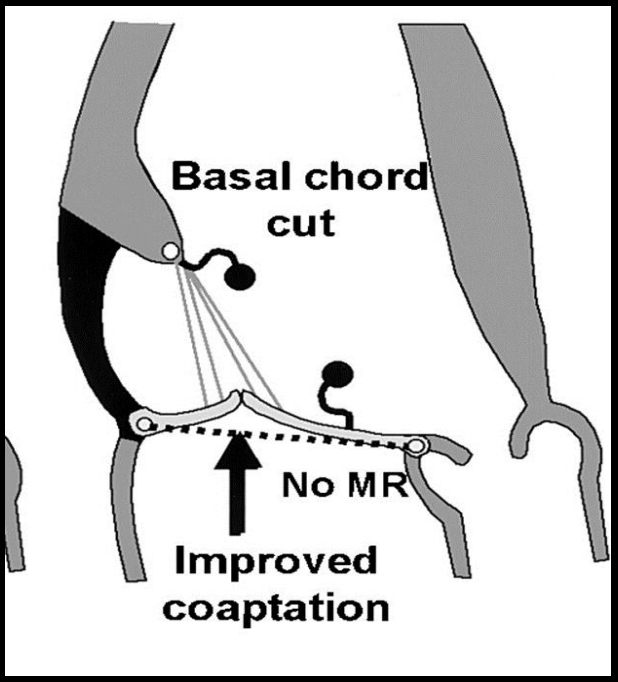
Kuwahara, E. et al. Circulation 2006;114:I-529-I-534

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.

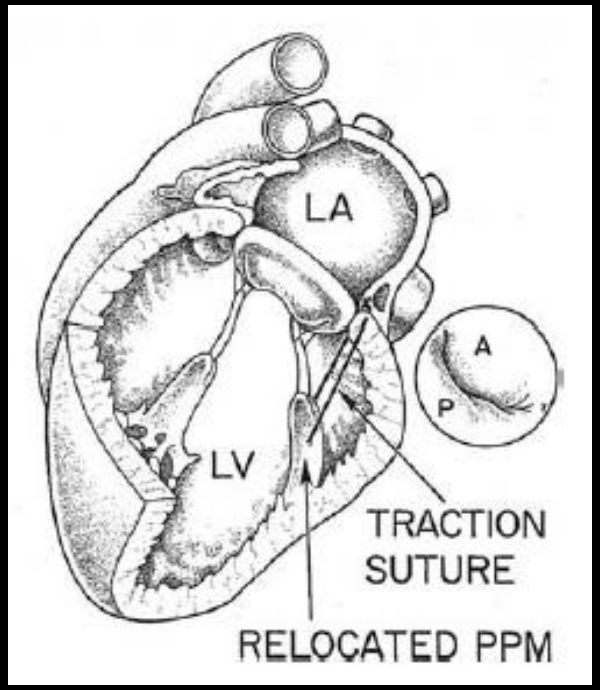
Attemps to improve durability of MVR in FIMR

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



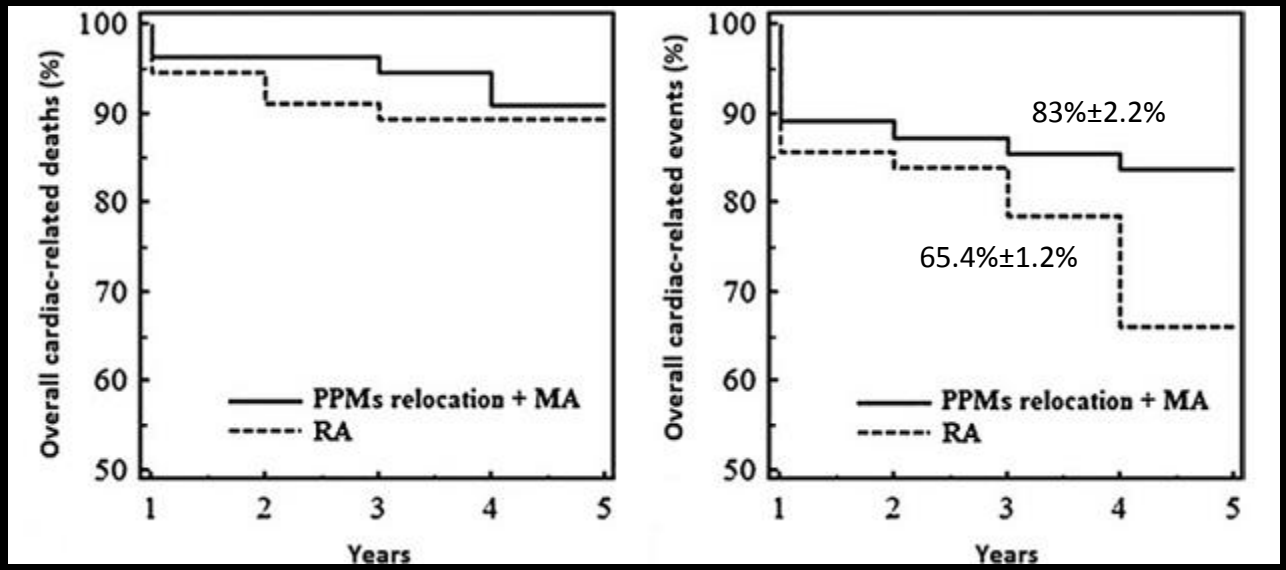
Surgical relocation of the posterior papillary muscle in chronic ischemic mitral regurgitation
Irving L. Kron, G. Randall Green and Jeffrey T. Cope
Ann Thorac Surg 2002;74:600-601

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

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.

Conclusions

- Moderate MR:

- Better patient's selection (which patients will benefit from CABG alone), myocardial viability, scare, tenting, etc…..

Conclusions

Severe MR

- Ischemic etiology of MR demands a different surgical approach in concomitant to annuloplasty

- better patients selection for isolated restrictive annuloplasty meanwhile add subannular techniques for a subgroup of patients with severe tenting

- Good repair is better than replacement in term of reverse LV remodelling

1⁰ endpoint LVESI - no change?

			N	Mean	Std	Median	Min	Max
	MR at 12 Months							
CABG Alone	None, Trace or Mild	Baseline LVESVI	80	59.62	26.30	55.80	16.00	124.90
		12 Month LVESVI	80	44.48	19.68	40.50	17.40	104.50
		Change (12 Month – Baseline)	80	-15.14	22.53	-10.40	-78.90	21.40
	Moderate or Severe	Baseline LVESVI	36	46.48	19.34	41.60	10.20	115.60
		12 Month LVESVI	36	50.44	26.71	47.70	14.00	141.00
		Change (12 Month – Baseline)	36	3.97	18.65	0.50	-16.20	71.80
CABG with Mitral Valve Repair	None, Trace or Mild	Baseline LVESVI	111	58.92	24.00	54.10	19.00	139.10
		12 Month LVESVI	111	45.08	21.39	39.60	15.00	121.50
		Change (12 Month – Baseline)	111	-11.84	19.93	-7.90	-96.20	32.80
	Moderate or Severe	Baseline LVESVI	14	73.33	32.72	68.05	33.90	161.00
		12 Month LVESVI	14	82.62	66.53	63.20	33.70	294.00
		Change (12 Month – Baseline)	14	9.29	38.21	0.50	-32.20	133.00

iFMR is bad !!

Treatment choice is controversial

- Lower perioperative morbidity and mortality with repair
  - Vasileva et al, Eur J Cardiothor Surg 2011; 39:295-303
- Better long-term correction with replacement
  - Di Salvo et al, J Am Coll Cardiol 2010; 55:271-82
  - Grossi et al, J Thorac Cardiovasc Surg 2001; 122:1107-24
  - Gillinov et al, J Thorac Cardiovasc Surg 2001; 122: 1125-41
- Based on retrospective observational studies
- Need randomized evidence