Surgical Challenges in IMR

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Tir 97 June 2018

Conflict of interest : None

Surgical vs Medical

Surgery benefit

Repair vs Replacement

Surgical techniques

Surgical vs Medical

Surgery benefit

Repair vs Replacement

Surgical techniques

Surgical vs Medical

Surgery benefit

Repair vs Replacement

Surgical techniques

Question 1

Surgical vs Medical

Mod IMR / Sever IMR

Although secondary MR can acutely be cor- rected by MV surgery, it has never clearly been demonstrated that reducing or eliminating the MR alters the natural history of the primary disease (dilated cardiomy- opathy) or improves survival.13,45-47 Moreover, whether the response to surgery differs in secondary MR due to ischemic versus nonischemic cardiomyopathy has not been established.

One-year mortality after MV surgery for severe IMR (with or without coronary artery bypass grafting [CABG]) is approximately 17%. Rates of postoperative moderate or severe MR at 1 year after MV repair of severe IMR are higher than previously appreciated.

Although MV repair with CABG is significantly more effective than CABG alone in reducing or eliminating moderate IMR, there are no between-group differences at 1 year in LV end-systolic volume index or rates of major adverse cardiac and cerebrovascular events.

Predictors and Prognostic Impact of Progressive Ischemic Mitral Regurgitation in Patients With Advanced Ischemic Cardiomyopathy

A Multimodality Study

Deborah H. Kwon, MD; Kenya Kusunose, MD, PhD; Nancy A. Obuchowski, PhD; João L. Cavalcante, MD; Zoran B. Popovic, MD, PhD; James D. Thomas, MD; Milind Y. Desai, MD; Scott D. Flamm, MD, MBA; Brian P. Griffin, MD

Imaging. 2016;9:e004577. DOI: 10.1161/CIRCIMAGING.115.004577.)

IMR frequently increases in severity, and progression is independently associated with adverse left ventricular remodeling and infarct size, as assessed by cardiac magnetic resonance.

Furthermore, IMR progression is a powerful independent predictor of adverse events, even after controlling for the severity of IMR at baseline.

ORIGINAL RESEARCH

American Heart Association | American Stroke Association

Predictors of Mortality in Patients With Severe Ischemic Cardiomyopathy Undergoing Surgical Mitral Valve Intervention

Kenya Kusunose, MD, PhD; Nancy A. Obuchowski, PhD; Marc Gillinov, MD; Zoran B. Popovic, MD, PhD; Scott D. Flamm, MD, MBA; Brian P. Griffin, MD; Deborah H. Kwon, MD

(J Am Heart Assoc. 2017

Clinical Perspective

What Is New?

- Our novel findings suggest that viability assessment with cardiac magnetic resonance provides prognostic significance in patients with ischemic cardiomyopathy who underwent subsequent mitral valve intervention (MVi) for significant ischemic mitral regurgitation.
- Patients with total scar % <25% experienced improved survival if complete revascularization was achieved concurrently with MVi.
- However, the mortality rate was higher in patients with total scar % ≥25%, despite complete revascularization at the time of MVi.
- Furthermore, patients with more severe ischemic mitral regurgitation and increased total scar % appear to have the highest risk of mortality, despite MVi.

Our study suggests that patients with total scar % ≥25% and significant ischemic mitral regurgitation are unlikely to benefit from MVi.

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

Post CABG IMR is Dynamic

Mod IMR dose not reliably resolve after CABG alone and

Associated with reduced survival

Curr Cardiol Rep (2016) 18: 22
DOI 10.1007/s11886-016-0701-5

Does Surgical Repair of Moderate Ischemic Mitral Regurgitation Improve Survival? A Systematic Review

Conclusion

In summary, our review suggests that there are conflicting results from different studies regarding survival benefit and improvement in the functional class after performing MVR in addition to CABG in moderate ischemic MR. Most of the studies we selected do not favor MVR as most of the studies failed to show any long-term survival benefit, and there is mixed data regarding improvement in functional status. However, these results cannot serve as guidelines and cannot be generalized as there are many flaws in study design of parent studies, differences in the baseline characteristics of patients in comparison groups, as well as potential for inherent biases. Large-scale RCTs are necessary to establish a universal approach that benefits patients with moderate ischemic regurgitation in terms of long-term and event-free survival and meaningful improvement in morbidity.

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J Card Surg. 2018;1–11.

11 Study (4 RCT)
1406 patients
CABG alone = 864 and CABG plus MVr = 542).

Adding MVr to revascularization → reduces MR grade on follow-up echocardiography → promotes ventricular remodeling, → no improvement in long-term survival or functional class.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Two-Year Outcomes of Surgical Treatment of Moderate Ischemic Mitral Regurgitation

CTSN trial

In patients with moderate ischemic mitral regurgitation undergoing CABG, the addition of mitral-valve repair did not lead to significant differences in left ventricular reverse remodeling at 2 years.

Mitral-valve repair provided a more durable correction of mitral regurgitation but did not significantly improve survival or reduce overall adverse events or readmissions and was associated with an early hazard

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

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

WJC | www.wjgnet.com 1218 November 26, 2014 | Volume 6 | Issue 11 |

- Moderate IMR should always be considered in patients undergoing other cardiac surgery.
- Restrictive annuloplasty alone fails as valid treatment because often associated with persistence and high recurrence rate of MR due to continuous ventricular remodeling.
- Probably more aggressive repair procedures addressing the subvalvular mitral apparatus would help to find more durable results for this complex disease.

ORIGINAL ARTICLE

Braz J Cardiovasc Surg 2018;33(1):15-22

OPCABG for Moderate CIMR in Elderly Patients: a Superior Option?

Amber Malhotra[1], M.Ch; Chandrasekaran Ananthanarayanan[1], M.Ch; Vivek Wadhawa[1], M.Ch; Sumbul Siddiqui[1], M.Ch; Pranav Sharma[1], M.Ch; Kartik Patel[1], MCh; Komal Shah[2], PhD; Pratik Shah[2], MSc

Table 3. Early operative outcome comparison in high operative risk subgroup (A).

Variables	IA – OPCABG N=35	IIA- CABG+MVRep N=20	*P* Value
Blood transfusion	2.3±0.6	3.1±0.9	<0.001
Postoperative IABP	3 (8		
Renal dysfunction	4 (1		
Arrhythmia	4 (1		
Liver dysfunction	3 (8		
New-onset stroke	2 (5		
Sepsis	3 (8		
30-day mortality	1 (2		
Ventilation (hours)	7.23		
ICU stay (days)	3.63		

Table 4. Early operative outcome comparison in low operative risk subgroup (B).

Variables	IB – OPCABG N=60	IIB- CABG+MVRep N=35	*P* Value
Blood transfusion	2.1±0.5	2.7±1.5	0.005
Postoperative IABP	5 (8.33%)	10 (28.57%)	0.02
Renal dysfunction	4 (6.67%)	10 (28.57%)	0.01
Arrhythmia	4 (6.67%)	7 (20%)	0.1
Liver dysfunction	3 (5%)	5 (14.29%)	0.23
New-onset stroke	3 (5%)	7 (20%)	0.05
Sepsis	3 (5%)	6 (17.14%)	0.11
30-day mortality	1 (1.67%)	6 (17.14%)	0.01
Ventilation (hours)	6.76±2.25	15.76±4.13	<0.001
ICU stay (days)	2.78±1.34	5.38±1.92	<0.001

OPCABG is recommended for moderate CIMR in elderly patients with high operative risk.

CABG+MVr can be considered for moderate CIMR in elderly patients with low operative risk,

but at the cost of higher early operative complications.

In summary

- Mild to mod. IMR: Negative impact on survival

  MVr improve functional status No survival benefit

- Mod IMR: No clinically meaningful benefit from MVr during 1yr F/U , CTSN trial

  but may long term survival benefit

  Especially in patient with low EF

- Sever IMR: MVr/MVR have symptomatic & survival benefit

Question 2

Surgical vs Medical

Repair vs Replacement

RA vs Additional techniques

Saddle shape vs Flat

Mitral valve replacement therapy causes higher 30-day postoperative mortality than mitral valvuloplasty in patients with severe ischemic mitral regurgitation: A meta-analysis of 12 studies

Jiayang Wang, Chengxiong Gu, Mingxin Gao, Wenyuan Yu, Yang Yu *

Department of Cardiac Surgery, Beijing An Zhen Hospital, Capital Medical University, Beijing 100029, China

International Journal of Cardiology 185 (2015) 304–307

Table 1
Characteristics of included studies (n = 12).

Author	Year	Study design	Study size	Surgical procedures and patients characteristics
Hickey	1988	OB	59	Patients undergoing valve replacement or repair in addition to coronary bypass for moderate and severe IMR
Gillinov	2001	OB	482	Patients undergoing either mitral valve repair or replacement for IMR
Mantovani	2004	OB	102	Patients with a preoperative diagnosis of CIMR, underwent mitral valve repair or prosthetic replacement, along with myocardial revascularization
Reece	2004	OB	110	Patients undergoing CABG and MVP or MVR for IMR
Al-Radi	2005	OB	202	Patients with IMR undergoing repair or replacement
Silberman	2006	OB	80	Patients with severely impaired LV function (ejection fraction < 25%) and severe IMR
Milano	2008	OB	522	Patients undergoing CABG and MVP or MVR for IMR
Micovic	2008	OB	138	Patients with IMR undergoing either MVR or MVP
Magne	2009	OB	370	Patients with CIMR who underwent mitral valve surgery
Bonis	2012	OB	132	Patients with advanced dilated and ischemic cardiomyopathy and severe functional MR and systolic dysfunction underwent mitral surgery in the same time frame.
Lorusso	2013	OB	488	Patients with CIMR and LV ejection fraction (LVEF) < 40% undergoing CABG procedure associated with MVP with downsizing ring annuloplasty or MVR.
Acker	2014	RCT	251	Patients with severe IMR undergoing either MVR or MVP

Systematic Review

A meta-analysis of mitral valve repair versus replacement for ischemic mitral regurgitation

Sohaib A. Virk[1], Arunan Sriravindrarajah[1], Douglas Dunn[1], Kevin Liou[2], Hugh Wolfenden[3], Genevieve Tan[3], Christopher Cao[1]

Ann Cardiothorac Surg 2015;4(5):400-410

Overall, 22 observational studies (n=3,815 patients) and one randomized controlled trial (n=251)

Background: The development of ischemic mitral regurgitation (IMR) portends a poor prognosis and is associated with adverse long-term outcomes. Although both mitral valve repair (MVr) and mitral valve replacement (MVR) have been performed in the surgical management of IMR, there remains uncertainty regarding the optimal approach. The aim of the present study was to meta-analyze these two procedures, with mortality as the primary endpoint.

Methods: Seven databases were systematically searched for studies reporting peri-operative or late mortality following MVr and MVR for IMR. Data were independently extracted by two reviewers and meta-analyzed according to pre-defined study selection criteria and clinical endpoints.

Results: Overall, 22 observational studies (n=3,815 patients) and one randomized controlled trial (n=251) were included. Meta-analysis demonstrated significantly reduced peri-operative mortality [relative risk (RR) 0.61; 95% confidence intervals (CI), 0.47-0.77; I^2=0%; P<0.001] and late mortality (RR, 0.78; 95% CI, 0.67-0.92; I^2=0%; P=0.002) following MVr. This finding was more pronounced in studies with longer follow-up beyond 3 years. At latest follow-up, recurrence of at least moderate mitral regurgitation (MR) was higher following MVr (RR, 5.21; 95% CI, 2.66-10.22; I^2=46%; P<0.001) but the incidence of mitral valve re-operations were similar.

Conclusions: In the present meta-analysis, MVr was associated with reduced peri-operative and late mortality compared to MVR, despite an increased recurrence of at least moderate MR at follow-up. However, these findings must be considered within the context of the differing patient characteristics that may affect allocation to MVr or MVR. Larger prospective studies are warranted to further compare long-term survival and freedom from re-intervention.

Keynote Lecture Series

Ann Cardiothorac Surg 2015;4(5):411-416

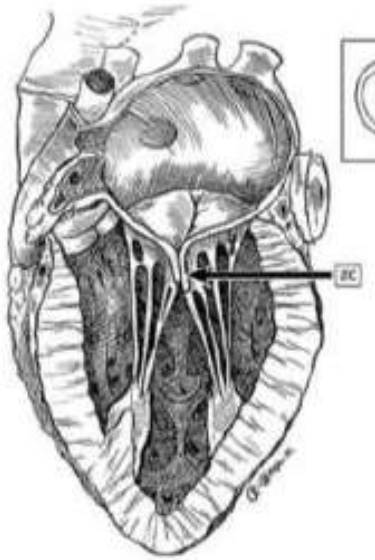
Repair or replace for severe ischemic mitral regurgitation: prospective randomized multicenter data

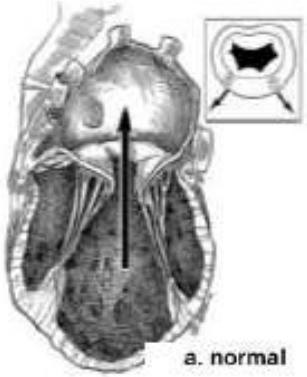
Damien J. LaPar[1], Michael A. Acker[2], Annetine C. Gelijns[3], Irving L. Kron[1]

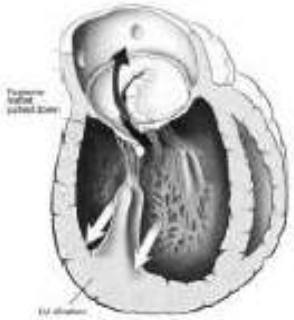
Conclusions

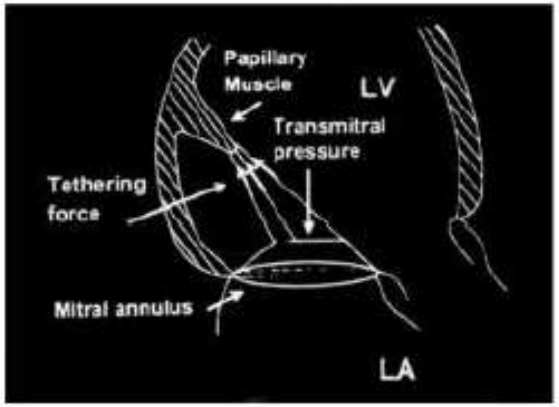
Level 1 randomized controlled data now exists to address the question of the most efficacious surgical approach to severe IMR. Severe IMR remains a significant clinical challenge in the modern surgical era that can be corrected with surgical mitral repair using restrictive annuloplasty or complete chordal sparing replacement techniques. Both surgical approaches improve LV remodeling with reduced LVESI at 12 months and are associated with similar 1-year mortality. Higher rates of recurrent MR after MV annuloplasty are more common among patients with preoperative evidence of basilar LV aneurysms and/or dyskinesis. For these patients, either MV replacement or repair techniques that address leaflet tethering may provide a more durable, long-term result. Multi-institution clinical trial collaborations are essential in the modern surgical era to most appropriately address areas of clinical equipoise in order to improve patient outcomes and provide generalizable consensus guidelines and treatment recommendations.

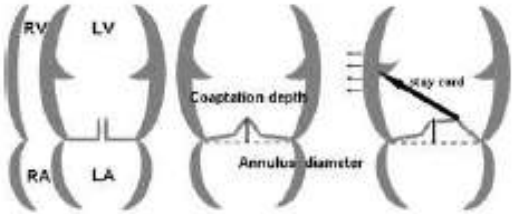
Carpentier Type 1+IIIb

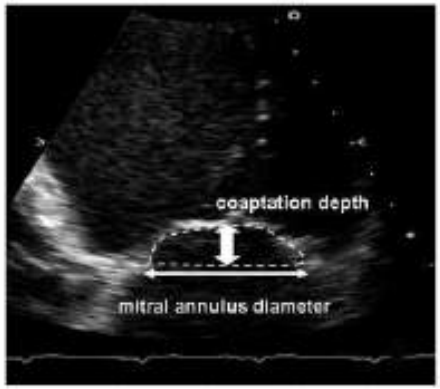


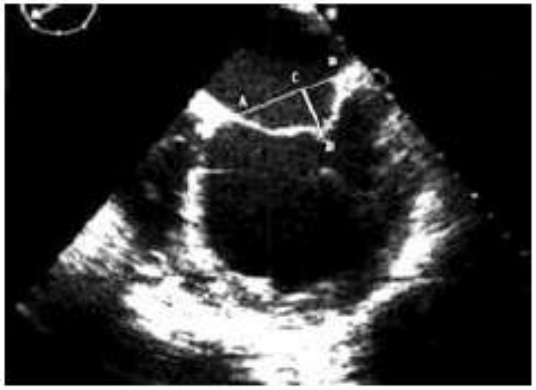


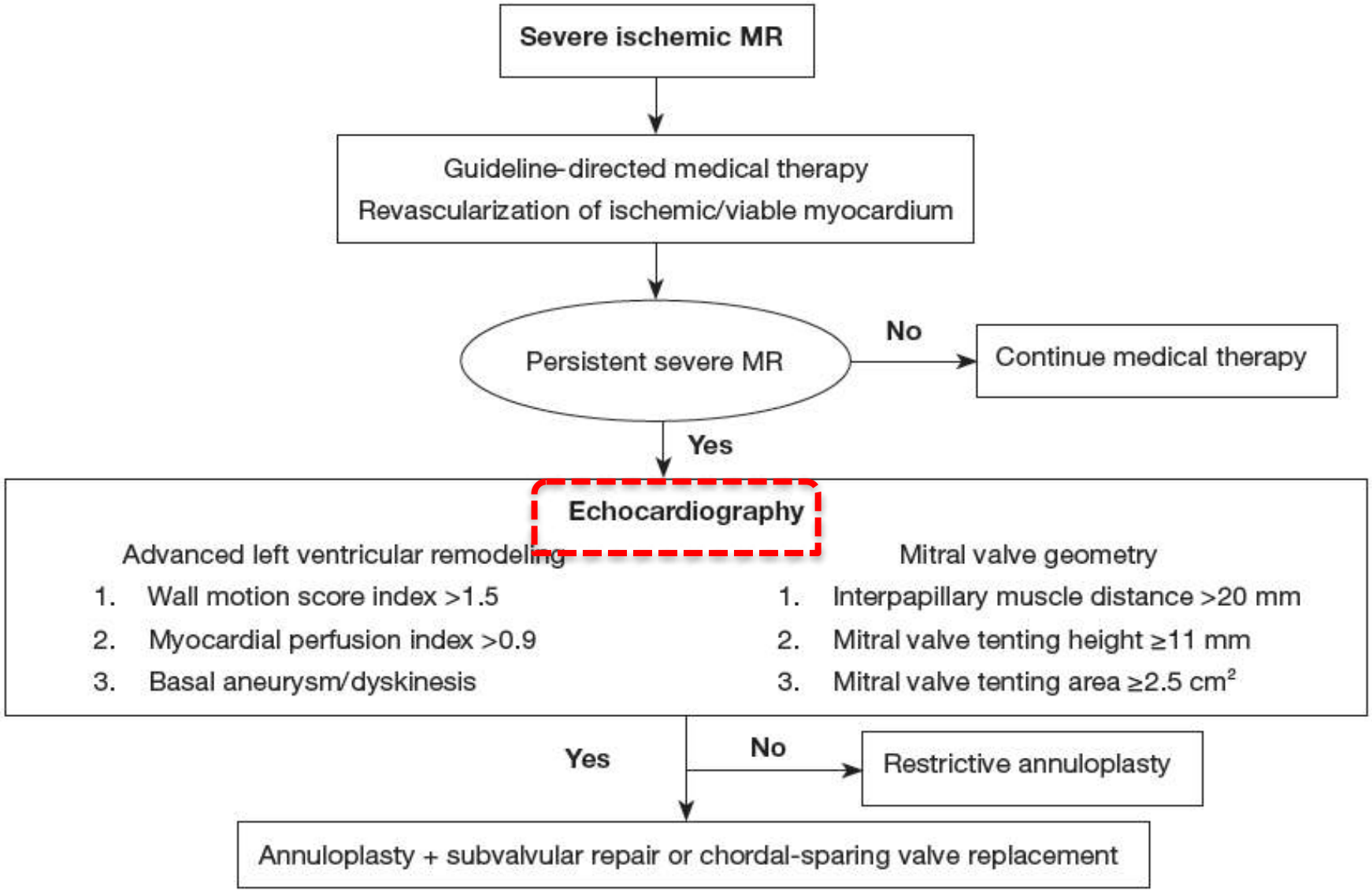











Severe ischemic MR
Guideline-directed medical therapy
Revascularization of ischemic/viable myocardium
Persistent severe MR
No
Continue medical therapy
Yes
Echocardiography
Advanced left ventricular remodeling
1. Wall motion score index >1.5
2. Myocardial perfusion index >0.9
3. Basal aneurysm/dyskinesis
Mitral valve geometry
1. Interpapillary muscle distance >20 mm
2. Mitral valve tenting height ≥11 mm
3. Mitral valve tenting area ≥2.5 cm²
Yes
No
Restrictive annuloplasty
Annuloplasty + subvalvular repair or chordal-sparing valve replacement

High risk of recurrent MR

- **Significant PML restriction *(preop systolic PML angle to the plane of mitral annulus > 45°)***

Magne et al Circulation 2007;11:782-91

- **Significant increase of PML tethering after *undersized mitral annuloplasty***

Zhu et al Circulation 2005;112 (9 suppl):I396-401

- **Coaptation distance *(the end-systolic distance between the coaptation point of the leaflets and the plane of mitral annulus) > 10 mm***

Calafiore et al Ann Thorac Surg 2001;71:1146-52

Published in final edited form as:
J Thorac Cardiovasc Surg. 2015 March ; 149(3): 752–61.e1. doi:10.1016/j.jtcvs.2014.10.120.

Predicting recurrent mitral regurgitation after mitral valve repair for severe ischemic mitral regurgitation

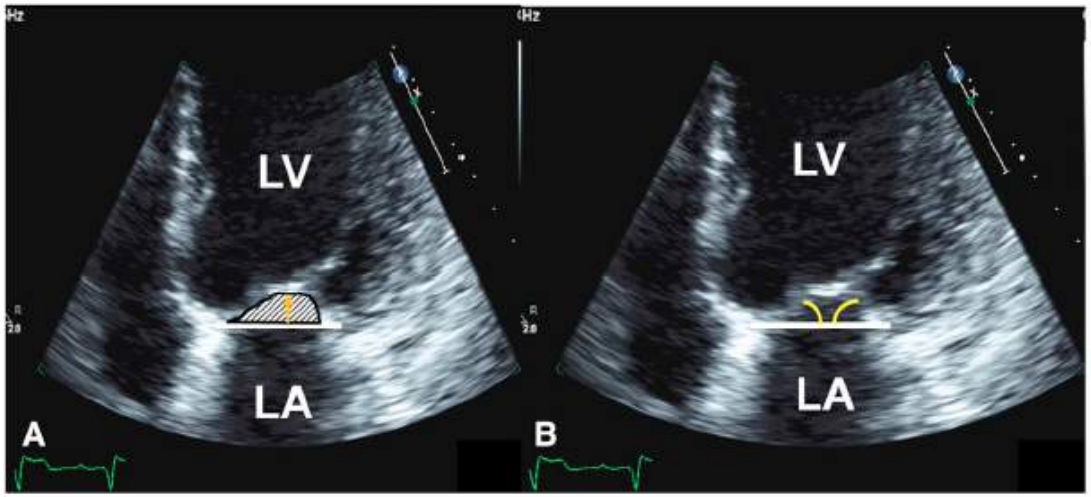


FIGURE 1.
Echocardiographic measures of MV tethering. A, MV tenting area (*hashmark area*) and MV tenting height (*gold arrow*). B, Anterior and posterior leaflet angle measurements (*yellow angle*). *LA*, Left atrium; *LV*, left ventricle.

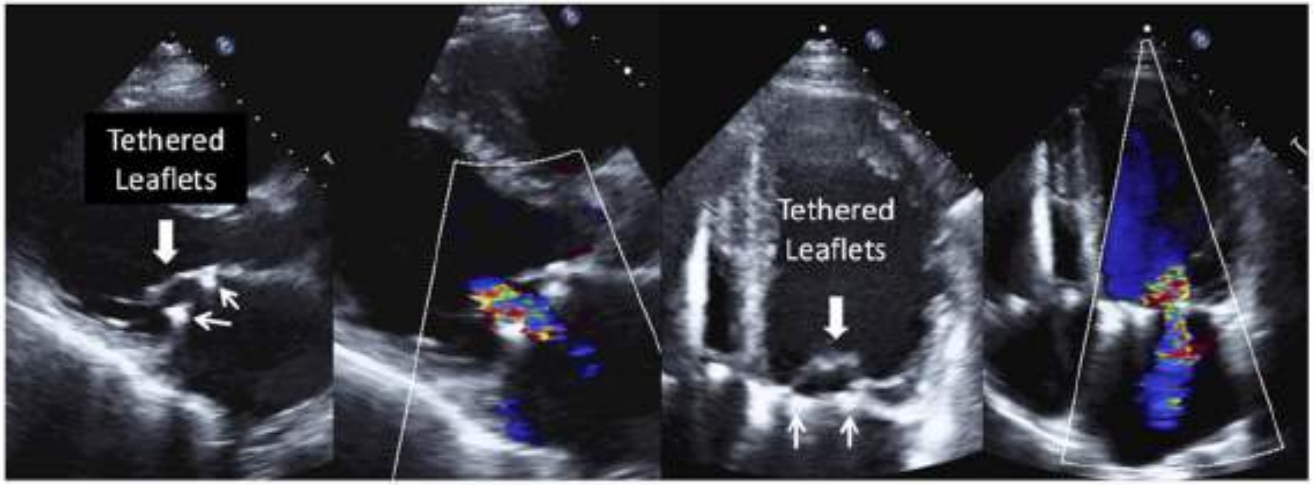


FIGURE 2.

Tethering mechanism for recurrent MR after repair. Mitral leaflets remain tethered (*large arrows*) after MV ring annuloplasty (*small arrows* show ring) with moderate MR (*blue* and *red* color flow).

A new approach: Ischemic mitral regurgitation guidelines *by* and *for* surgeons

Patrick M. McCarthy, MD

lines in Table 3 of the Kron document. The American Association for Thoracic Surgery guidelines for surgeons get "down in the weeds" and recommend replacement for patients with a basal aneurysm (dyskinesis), significant echocardiographic evidence of leaflet tethering, or moderate to severe left ventricular remodeling (left ventricular end-diastolic diameter >65 mm). They further recommend preserving both anterior and posterior cords during replacement. These are significant advances in our understanding of the surgical treatment of IMR. For years, we have known that severe tethering is one of the risk factors for repair failure. Going forward, we have 3 choices: to identify the patients before surgery who are at high risk for repair failure and treat those with a cord-sparing replacement; to come up with a better way to do repair (likely involving the subvalvular apparatus), such that the repair becomes durable; or just to replace all valves with IMR.

Basal aneurysm is a risk factor for repair failure.

Surgical vs Medical

Repair vs Replacement

RA vs Additional Techniques

Saddle shape vs Flat

Ann Thorac Cardiovasc Surg 2015; 21: 370–377

Online February 16, 2015
doi: 10.5761/atcs.oa.14-00204

Original Article

Surgical Strategy for Ischemic Mitral Regurgitation Adopting Subvalvular and Ventricular Procedures

Table 1 Clinical stages of ischemic mitral regurgitation and surgical procedures

	Stage 1	Stage 2	Stage 3
Severity of MV tethering and LV remodeling			
MV tethering	Not extensive (CD <10 mm and IPMD <30 mm)	Extensive (CD ≥10 mm or IPMD ≥30 mm)	Extensive (CD ≥10 mm or IPMD ≥30 mm)
LV remodeling	Small LV (LVDd <65 mm)	Small LV (LVDd <65 mm) or large LV (LVDd ≥65 mm) with a small scar or no scar	Large LV (LVDd ≥65 mm) with a large scar
Surgical procedures			
Valvular	Annuloplasty (downsized)	Annuloplasty (true-sized)	Annuloplasty (true-sized)
Subvalvular	None	PMA (transvalvular or transventricular)	PMA (transventricular)
Ventricular	None	None	Left ventriculoplasty

CD: coaptation distance; IPMD: interpapillary muscle distance; LV: left ventricle; LVDd: LV end-diastolic diameter; MV: mitral valve; PMA: papillary muscle approximation

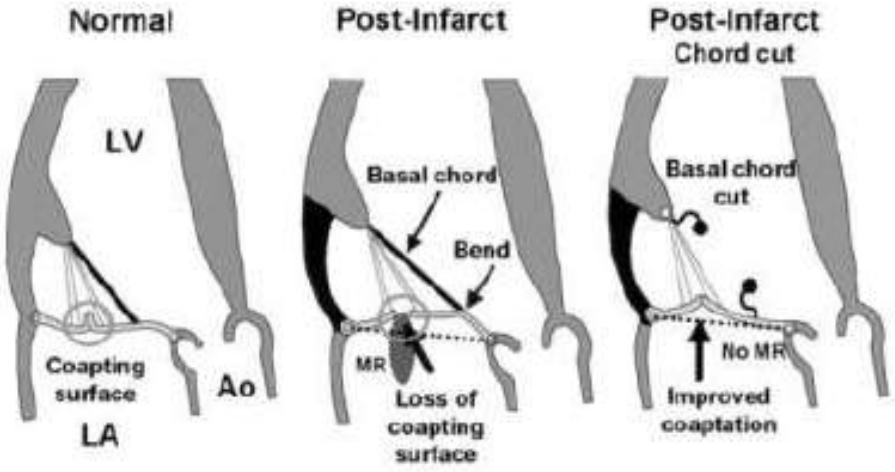
What should be the optimal surgical target or structure in the correction of ischemic MR ?

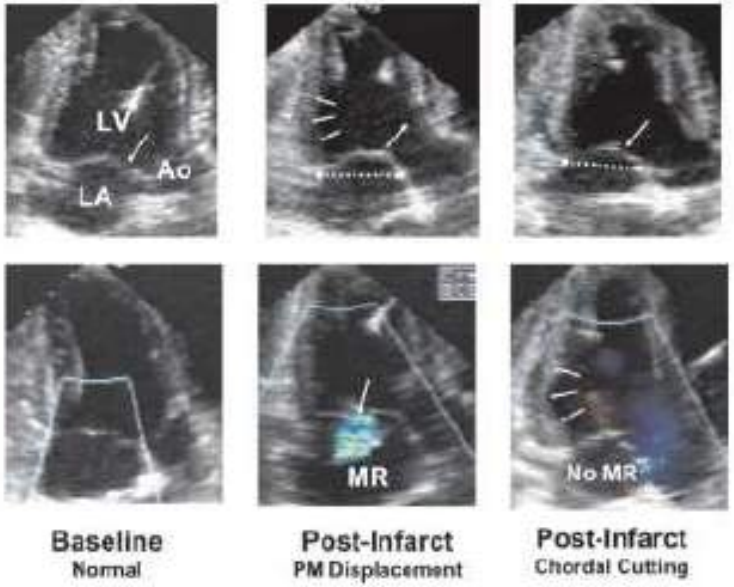
- Annulus : Undersized mitral annuloplasty
- Chordae tendinae
- Left ventricle
- Papillary muscles

Secondary chordal cutting

Messas et al Circulation 2001;104:1958-63
Borger et al. JTCVS 2007;133:1483-92

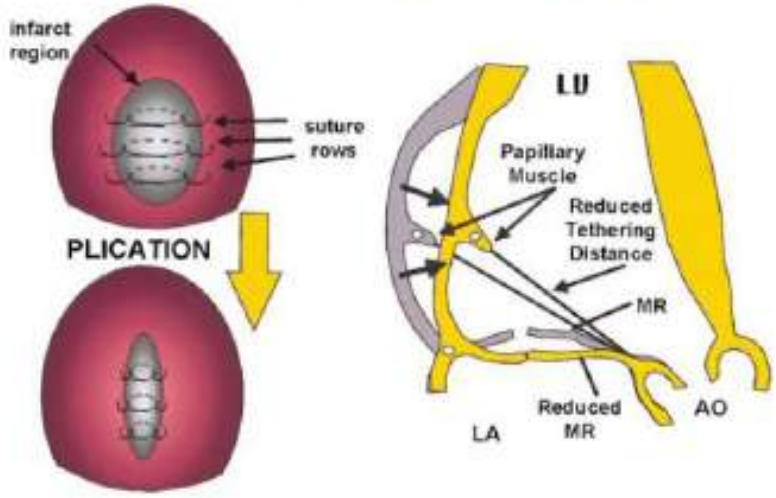
- Improve leaflet coaptation by eliminating the bend in the anterior leaflet

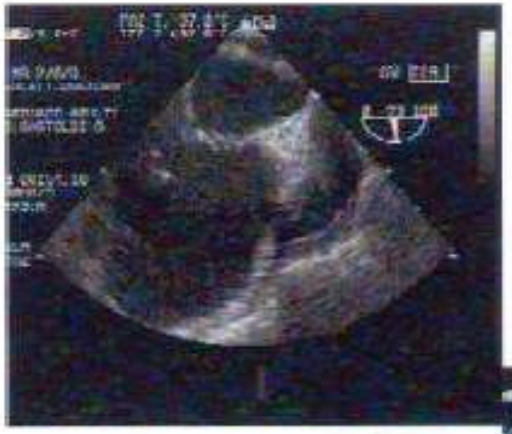




Ventricular restoration

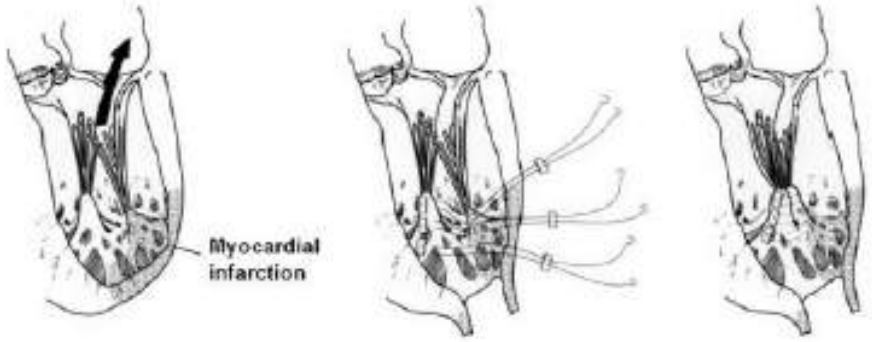
- Reducing the longitudinal length of the posterolateral fibrous scarring either by direct plication or by a small endoventricular patch
  - *Ramadan et al JTCVS 2005;129:440-2*
  - *Tanaka et al JTCVS 2007;133:1633-5*



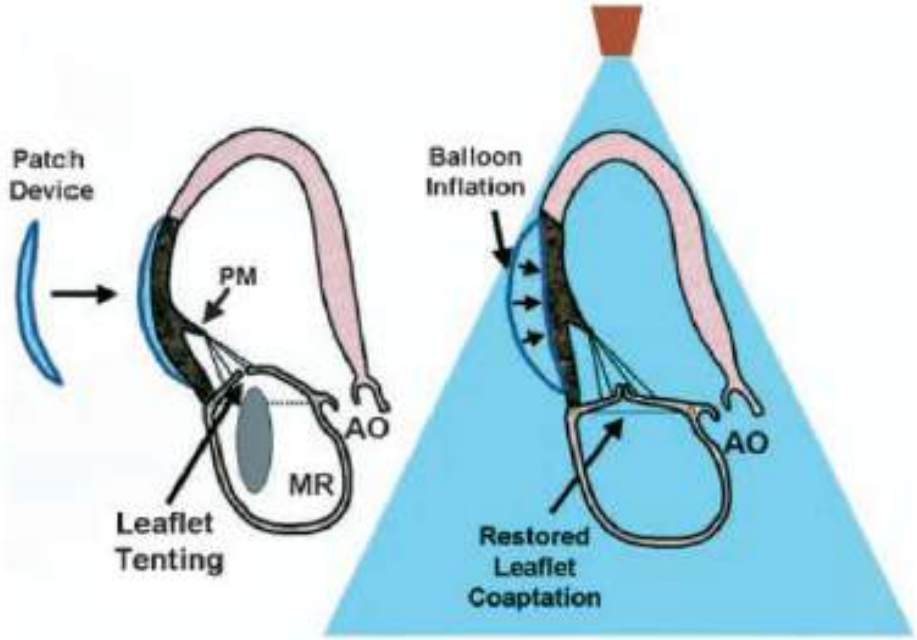


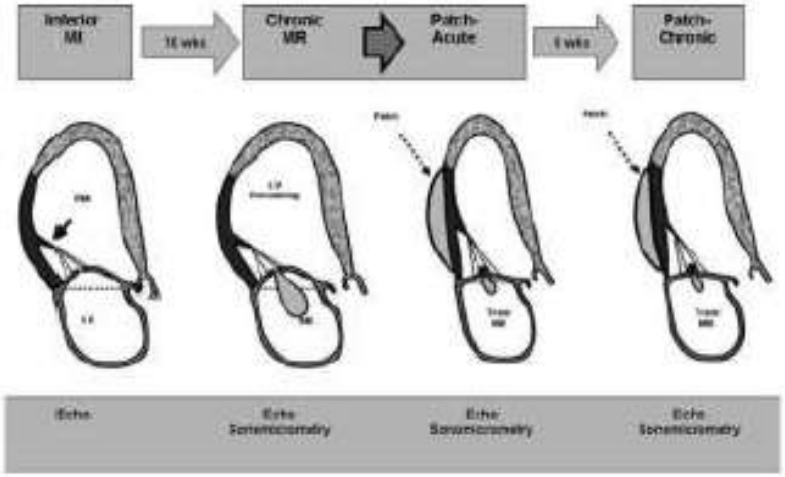
Plicating the interpapillary myocardium in combination with LV restoration

– *Irie et al JTCVS 2006;131:233-5*



VENTRICULAR RESTORATION
Patch-balloon device:Echo-guided device application in the beating heart
Hung et al Circulation 2002;106;2594-2600

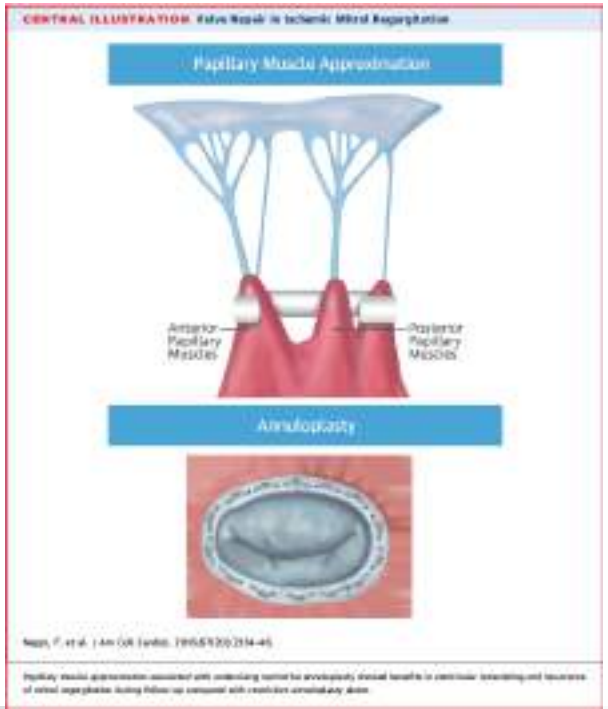


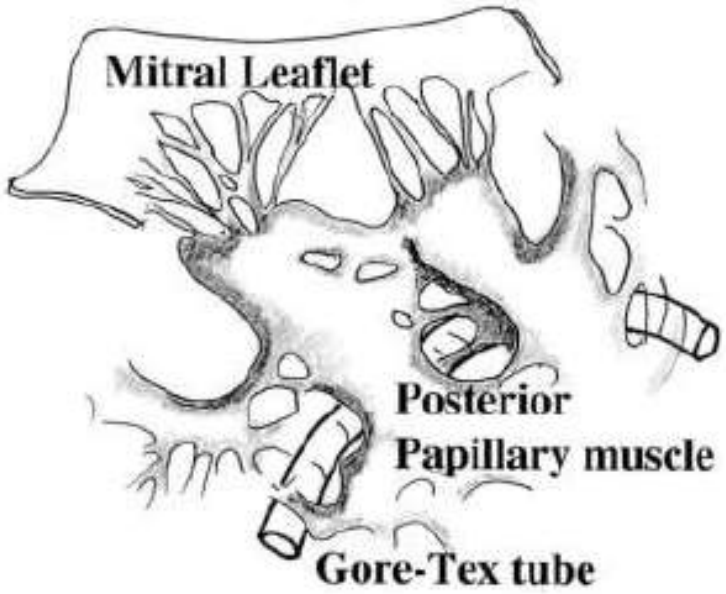


Papillary muscle relocation

Approximation of the two PMs by the sling technique

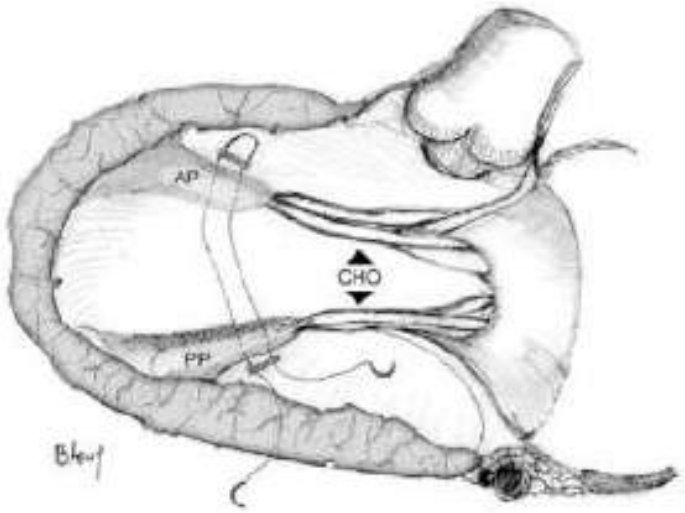
– *Hvass et al Ann Thorac Surg 2003;75:809-11*

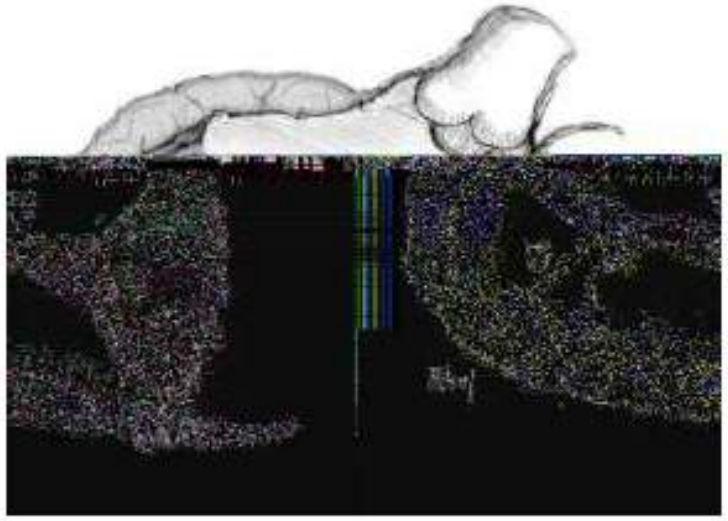




Direct suturing of both PM tips

Rama et al Ann Thorac Surg 2007;84:2130-1

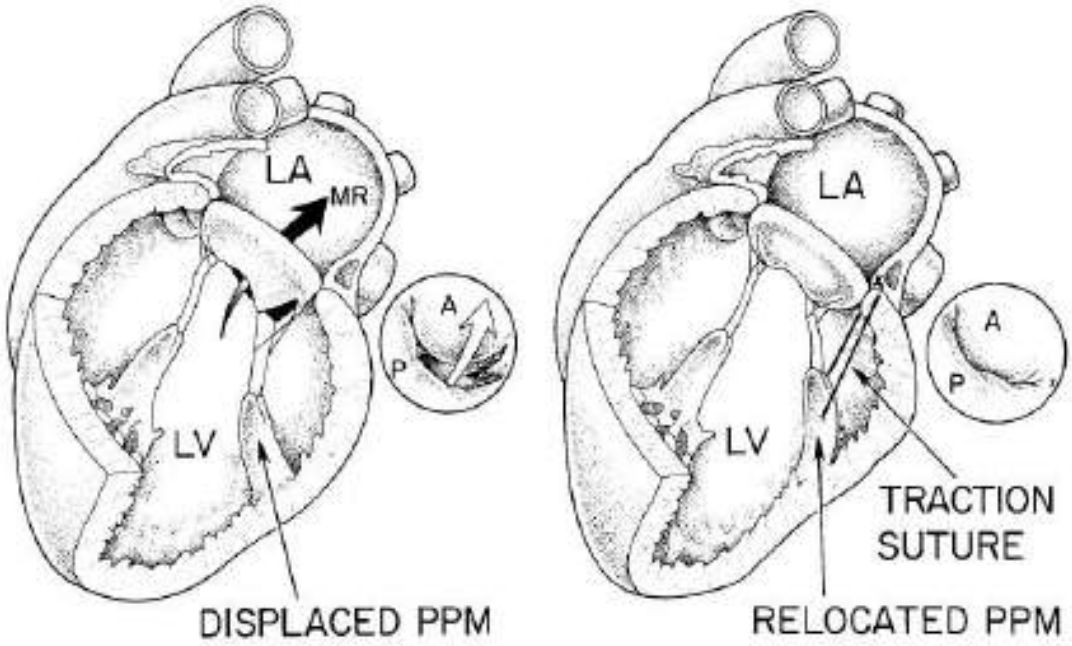




Kron's procedure

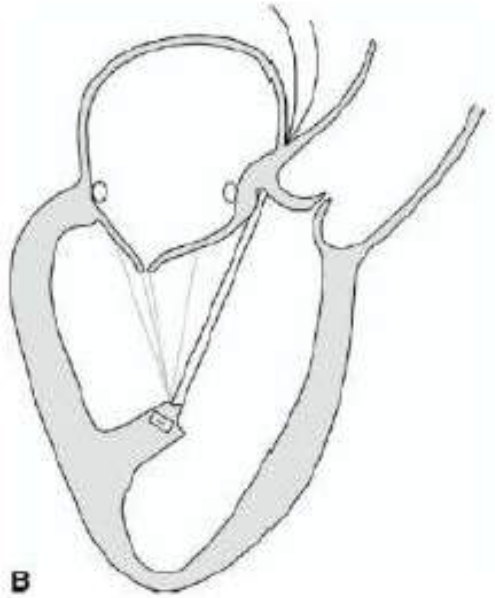
Kron et al Ann Thorac Surg 2002;74:600-1

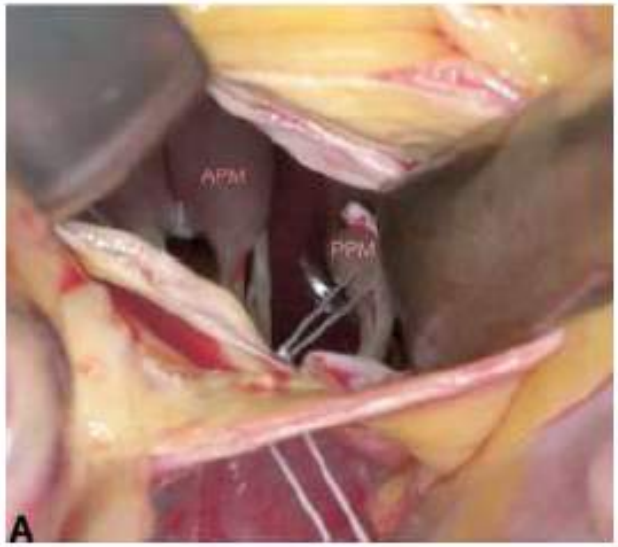
- Relocation of the posterior PM by suspending its tip closer to the mitral annulus posterior to the right fibrous trigone



Modified posterior PM relocation by a transventricular suture technique

Langer et al. JTCVS 2007;133:247-9





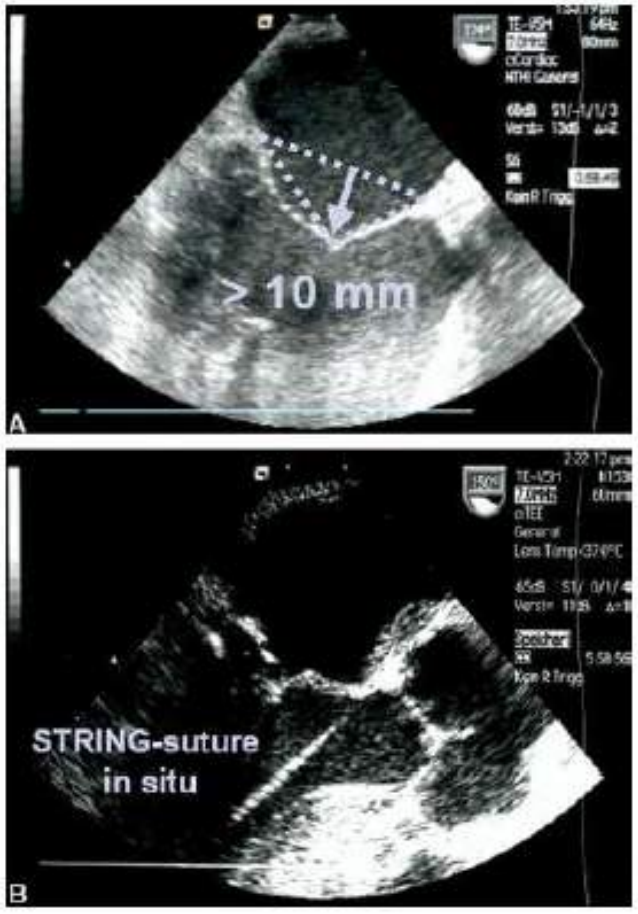


TABLE 1. Adjunctive papillary muscle interventions for ischemic mitral regurgitation

Procedure	Surgical technique
Papillary muscle sling	• Placement of a 4-mm polytetrafluoroethylene sling around each papillary muscle base • Anchored by weaving the graft between the ventricular trabeculae • Annuloplasty ring size based on size of the anterior leaflet
U-shaped suturing	• Single 2-0, U-shaped suture passed through the middle height of the papillary muscles • Reinforced by 2 patches of autologous pericardium • Undersized ring annuloplasty
Papillary muscle realignment	• 2 to 3 mattress sutures placed through the base and body of each papillary muscle, avoiding the fibrous tips • Tied to create contact between the muscles • Undersized ring annuloplasty
"Ring + String"	• Transventricular suture through the tip of the posterior papillary muscle to the intervalvular fibrosa • Suture exteriorized through the aortic wall • Undersized ring annuloplasty
Posterior papillary muscle relocation	• Suture of the posterior papillary muscle tip through the posterior annulus • Placed posterior to the right fibrous trigone • Undersized ring annuloplasty
Papillary muscle elevation	• 2 felt-reinforced sutures on either side of the posterior papillary muscle base used to elevate the muscle • Via ventriculotomy and concomitant plication of the infarcted wall • Undersized ring annuloplasty
Mitral complex remodeling	• Multifaceted approach 1. Secondary chordal cutting 2. Polytetrafluoroethylene (Gore-Tex, registered trademark of W. L. Gore & Associates, Inc, Flagstaff, Ariz) artificial chords from both papillary muscles to the anterior mitral leaflet 3. Two sutures from each papillary muscle to the posterior annulus for realignment 4. Undersized ring annuloplasty

Perspective

Ann Cardiothorac Surg 2015;4(5):443-448

A novel approach to ischemic mitral regurgitation (IMR)

David H. Scoville, Jack B. H. Boyd

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	MVR	Mini-MVR	PEER
CABG	CABG + MVR	CABG + mini-MVR	CABG + PEER
HCR	HCR + MVR	HCR + mini-MVR	HCR + PEER
PCI	PCI + MVR	PCI + mini-MVR	PCI + PEER

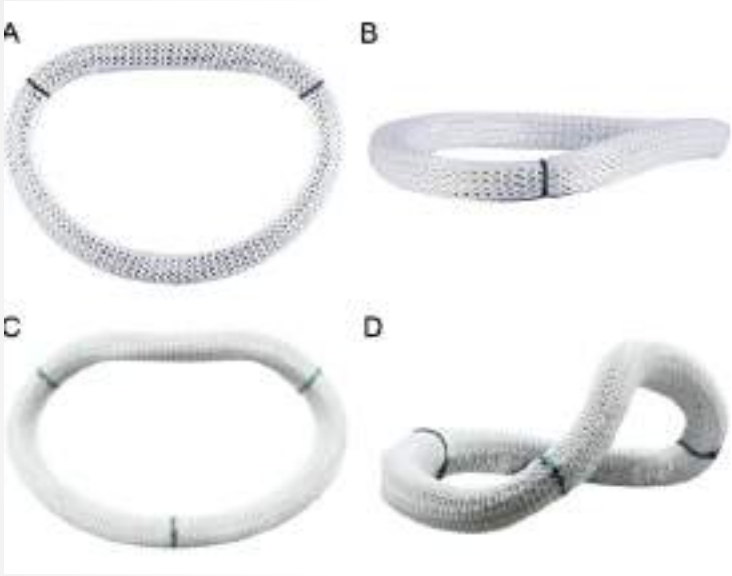
Surgical vs Medical

RA vs Additional Techniques

Saddle shape vs Flat ring

Saddle-Shaped Annuloplasty Improves Leaflet Coaptation in Repair for Ischemic Mitral Regurgitation

Wobbe Bouma, MD,* Chikashi Aoki, MD,* Mathieu Vergnat, MD, Alison M. Pouch, PhD, Shanna R. Sprinkle, MD, Matthew J. Gillespie, MD, Massimo A. Mariani, MD, PhD, Benjamin M. Jackson, MD, Robert C. Gorman, MD, and Joseph H. Gorman, III, MD



Conclusions. This study shows that the use of undersized saddle-shaped annuloplasty rings in mitral valve repair for IMR improves leaflet coaptation, whereas the use of undersized flat annuloplasty rings worsens leaflet coaptation. Because one of Carpentier's fundamental principles of mitral valve repair (durability) is to create a large surface of coaptation, saddle-shaped annuloplasty may increase repair durability.

Flat annuloplasty rings may leave up to 30% of patients with residual or recurrent MR

Gillinov et al. JTCVS 2001;122:1125-41

McGee et al JTCVS 2004;128:916-24

Filsoufi et al Mt Sinai J Med 2005;72:105-15

IMR surgery is complex

No Standard approach

Management should Individualized

MR severity

Table 4 Guideline based reference ranges for grading mr 2014 AHA/ACC Guidelines

2014 AHA/ACC Guidelines

Parameter	Stage A "At risk"	Stage B "Progressive"	Stage C "Asymptomatic Severe"	Stage D "Symptomatic Severe"
Valve apparatus and anatomy	CAD or cardiomyopathy, with normal valve leaflets, chords, annulus	Regional WMA with mild tethering of MV	Regional WMA ± LV dilatation with severe tethering of MV	Regional WMA ± LV dilatation with severe tethering of MV
		Annular dilatation with mild loss of central coaptation	Annular dilatation with severe loss of central coaptation	Annular dilatation with severe loss of central coaptation
LV (ischemic or primary myocardial disease)	No or mild dilatation with infarct or inducible ischemia, or cardiomyopathy with LV systolic dysfunction and dilatation	Regional WMA with reduced LV systolic function ± dilatation	Regional WMA with reduced LV systolic function ± dilatation	Regional WMA with reduced LV systolic function ± dilatation
Symptoms	May be present, may respond to GDMT	May be present, may respond to GDMT	May be present, may respond to GDMT	Symptoms persist despite GDMT
EROA-CMR (cm^2)	< 0.2	< 0.2	≥ 0.2	≥ 0.2
Jet/LA area	No MR jet or jet area/LA area <20%	20-39%	≥ 40%	≥ 40%
VC width (cm)	< 0.3		≥ 0.7	≥ 0.7
Regurgitant Fraction		< 50%	≥ 50%	≥ 50%
Regurgitant Volume		< 30 mL	≥ 30 mL	≥ 30 mL

Alajaji et al. BMC Res Notes (2015) 8:712
DOI 10.1186/s13104-015-1704-9

BMC Research Notes

RESEARCH ARTICLE Open Access

Surgical versus medical management of patients with acute ischemic mitral regurgitation: a systematic review

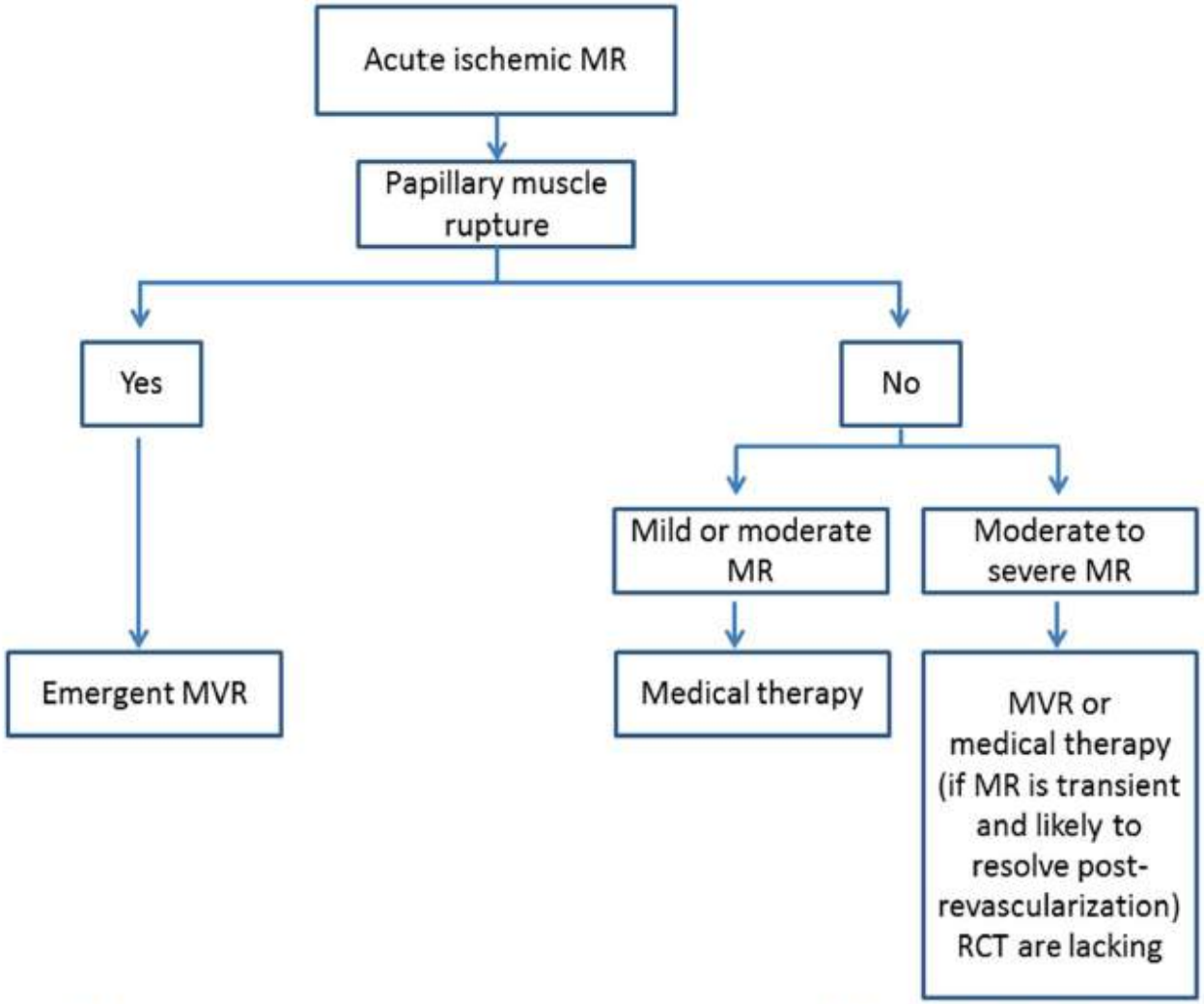


Fig. 1 Proposed algorithm for management of patients with acute ischemic mitral regurgitation. *MR* mitral regurgitation; *MVR* mitral valve replacement/repair; *RCT* randomized clinical trial

In absence of robust data, the management of acute ischemic MR mostly remains based on expert opinion.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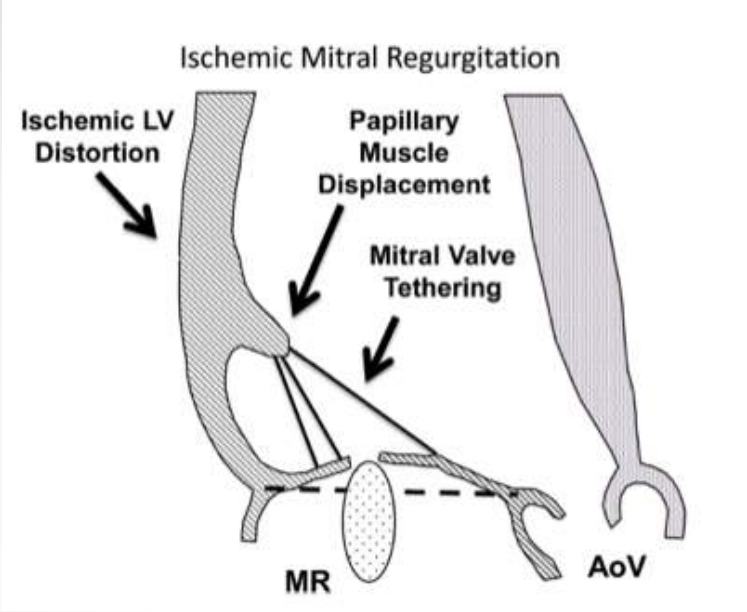
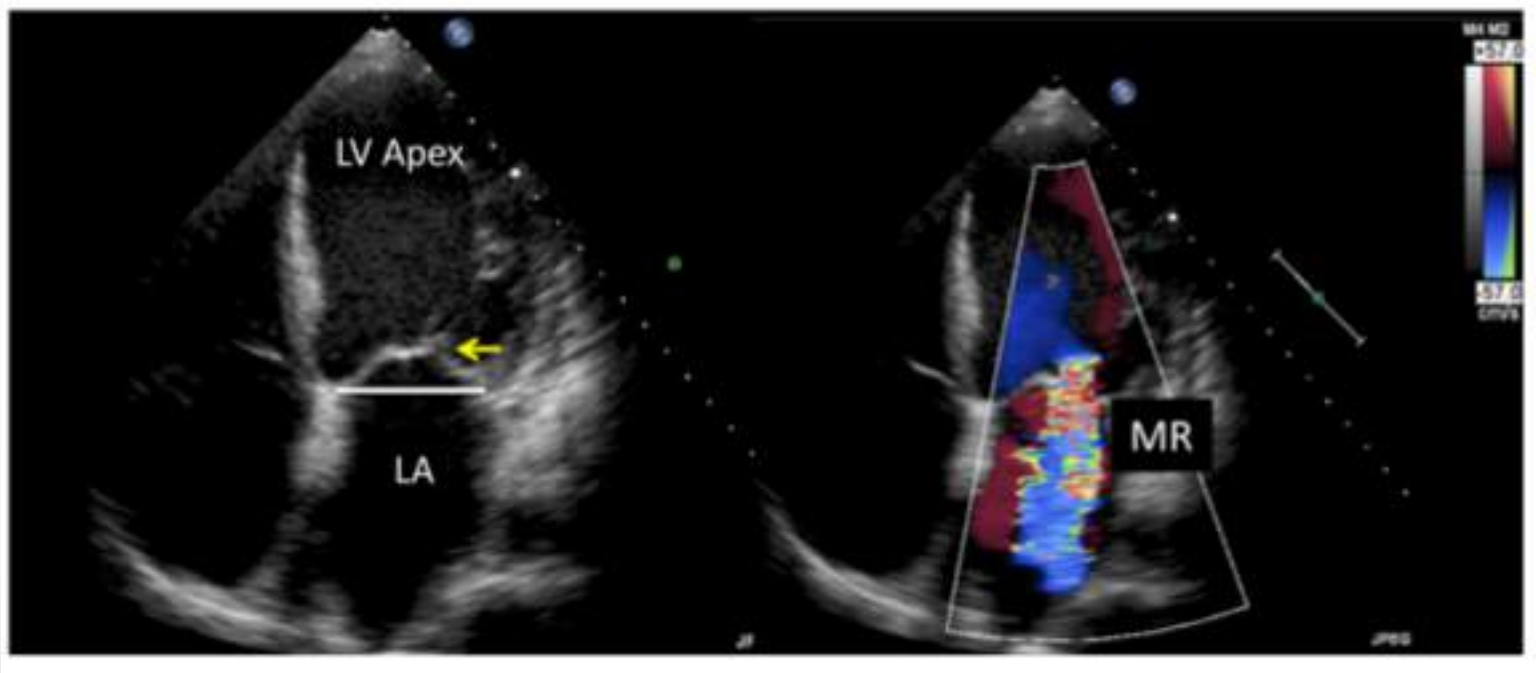

Ischemic Mitral Regurgitation
Ischemic LV Distortion
Papillary Muscle Displacement
Mitral Valve Tethering
MR
AoV


LV Apex
LA
MR

Lorusso and colleagues54 reported no difference in short- or long-term mortality between pa- tients treated with MV replacement and those treated with MV repair. They also found no differences found between groups in late LV function, cardiac- and valve-related death, or patients' functional capacity.

n the propensity-matched study, MV repair was the strongest predictor of the need for a valve-related reoperation. In the randomized study, recur- rence of MR in surviving patients was 32.6% at 1 year and 46% at 2 years.54

TABLE 2. Summary comparison of existing society guidelines and AATS guidelines for surgical treatment of IMR

Existing society guidelines	AATS guidelines
Moderate IMR A. MV repair can be considered at time of CABG (**COR IIb, LOE B**) B. MV surgery can be considered at time of other cardiac surgery (eg, AVR) (**COR IIb, LOE C**)	Moderate IMR A. Patients with moderate IMR undergoing CABG should undergo concomitant MV repair with an undersized complete rigid annuloplasty ring to mitigate recurrence of MR in patients who have heart failure symptoms, those with significant mitral annular dilation and those in whom bypassable, hibernating, viable myocardium supporting the papillary muscle(s) is thought to be minimal (**COR IIb, LOC A**).
Severe IMR A. MV surgery is reasonable at time of CABG or other cardiac surgery (eg, AVR) (**COR IIa, LOE C**) B. MV surgery can be considered as an isolated procedure for treatment of significant heart failure symptoms that persist despite guideline directed medical therapy (**COR IIb, LOE C**)	Severe IMR A. In the presence of basal aneurysm/dyskinesis, significant echocardiographic evidence of leaflet tethering, or moderate to severe LV remodeling (LVEDD >65), patients should consider MV replacement (**COR IIa, LOE A**) B. In the absence of basal aneurysm/dyskinesis, echocardiographic evidence of significant leaflet tethering, or moderate to severe LV remodeling (LVEDD < 65), patients should consider MV repair with an undersized complete rigid ring (**COR IIb, LOE B**).
MV replacement vs repair Not available	MV replacement vs repair A. MV replacement for IMR is performed with complete preservation of both anterior and posterior leaflet chords (**COR I, LOE B**) B. MV repair for IMR is performed with a small undersized complete rigid annuloplasty ring (**COR IIa, LOE B**)

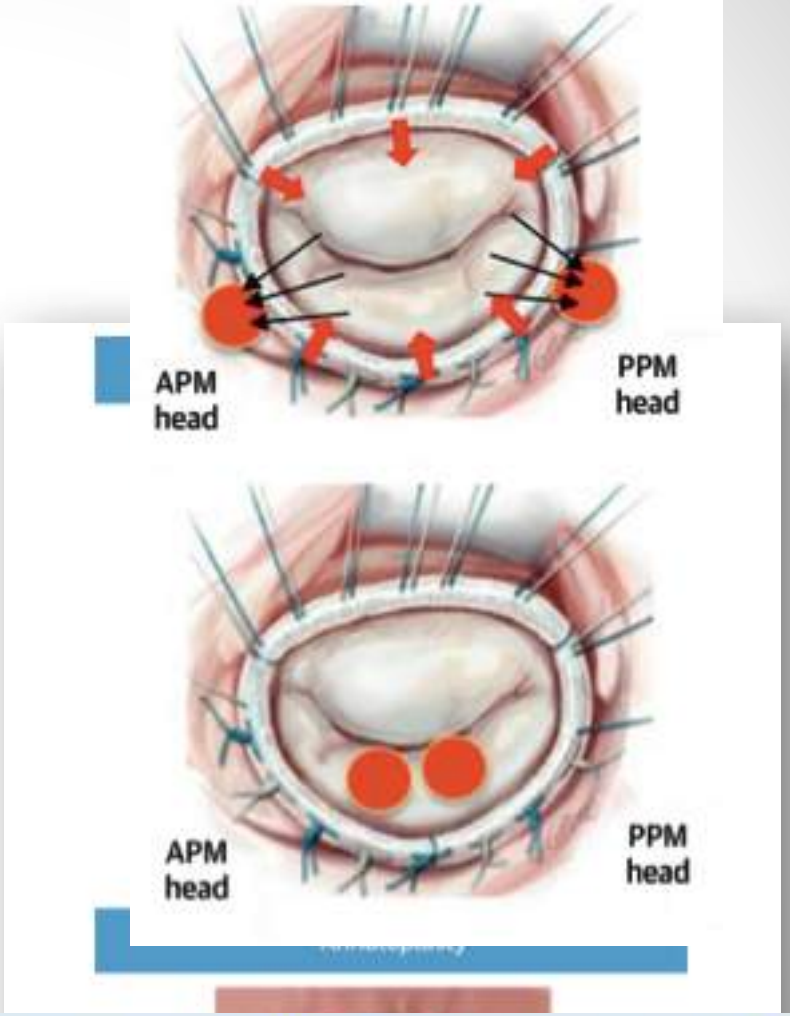
AATS, The American Association for Thoracic Surgery; *IMR*, ischemic mitral regurgitation; *MV*, mitral valve; *CABG*, coronary artery bypass grafting; *COR*, class of recommendation; *LOE*, level of evidence; *AVR*, aortic valve replacement; *LV*, left ventricle; *LVEDD*, left ventricular end-diastolic diameter.

- MV replacement should be a total valve-sparing replacement.
- For IMR, non–valve-sparing MV replacement should be completely abandoned.

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
© 2016 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION
PUBLISHED BY ELSEVIER
VOL. 67, NO. 20, 2016
ISSN 0735-1097/$36.00

Papillary Muscle Approximation Versus Restrictive Annuloplasty Alone for Severe Ischemic Mitral Regurgitation

Francesco Nappi, MD,[a,b] Mario Lusini, MD, PhD,[a] Cristiano Spadaccio, MD, PhD,[b,c] Antonio Nenna, MD,[a] Elvio Covino, MD,[a] Christophe Acar, MD, PhD,[c] Massimo Chello, MD[a]



CONCLUSIONS Compared with RA only, PMA exerted a long-term beneficial effect on left ventricular remodeling and more effectively restored the mitral valve geometric configuration in ischemic MR, which improved long-term cardiac outcomes, but did not produce differences in overall mortality and QOL. (J Am Coll Cardiol 2016;67:2334–46)

RESEARCH ARTICLE Open Access

Surgical versus medical management of patients with acute ischemic mitral regurgitation: a systematic review

Wissam A. Alajaji[1], Elie A. Akl[2,3], Aida Farha[4], Wael A. Jaber[5] and Wael A. AlJaroudi[6*]

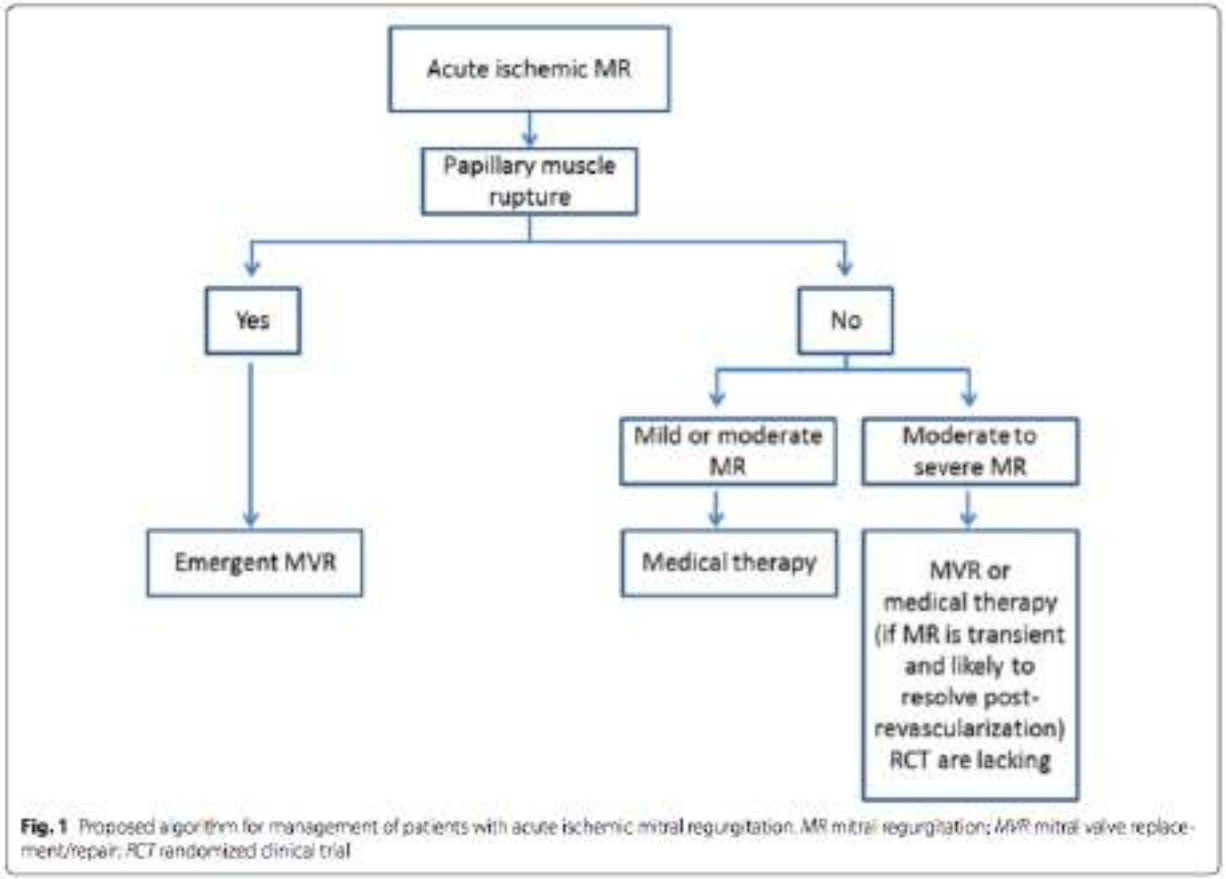


Fig. 1 Proposed algorithm for management of patients with acute ischemic mitral regurgitation. *MR* mitral regurgitation; *MVR* mitral valve replacement/repair; *RCT* randomized clinical trial

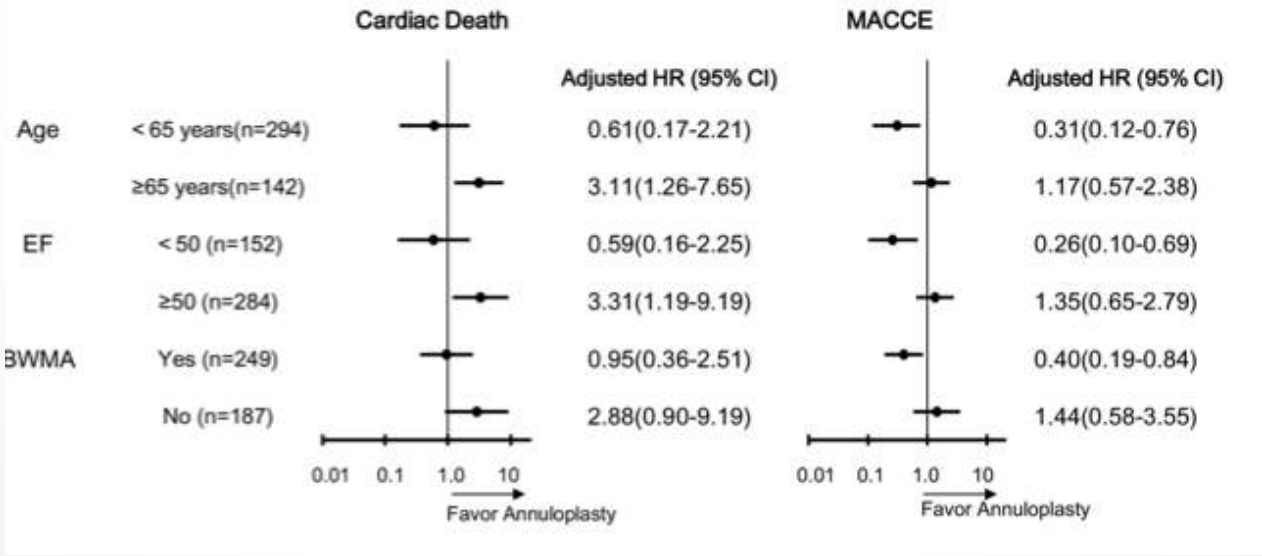
Mitral valve annuloplasty versus replacement for severe ischemic mitral regurgitation

Baotong Li, Shanglin Chen, Hansong Sun, Jianping Xu, Yunhu Song, Wei Wang & Shuiyun Wang

www.nature.com/scientificreports

Published online: 24 January 2018

437 pts



- MVA provides better results in freedom from cardiac death in subgroups of age ≥65years and left ventricular ejection fraction (EF) ≥50% (*P* = 0.014 and
- *P* = 0.016, respectively),

- whereas MVR was associated with a lower risk of MACCE in subgroups of age <65years, EF <50% and left ventricular inferior basal wall motion abnormality (BWMA) (all *P* < 0.05)

The choice of MVA or MVR should depend on major high-risk clinical factors.

CARDIOLOGY JOURNAL

Published online: 2018-03-02

Predicting functional mitral stenosis after restrictive annuloplasty for ischemic mitral regurgitation

Authors: Baotong Li, Hengchao Wu, Hansong Sun, Jianping Xu, Yunhu Song, Wei

Annuloplasty size ≤ 27 mm and early postoperative PPG ≥ 7.4 mmHg can predict clinically significant functional MS at 6–12 months after surgery.

Review

Perfusion

Are adjunct subvalvular techniques more effective than isolated restrictive annuloplasty for treating ischemic mitral regurgitation?

Perfusion
2017, Vol. 32(2) 92–96

DOI: 10.1177/0267659116662520
journals.sagepub.com/home/prf
SAGE

Leonidas V. Athanasopoulos,[1] Marco Moscarelli,[2] Giuseppe Speziale,[2] Prakash P. Punjabi[1] and Thanos Athanasiou[1]

10 article

Conclusion

The various subvalvular techniques for addressing ischemic MR are safe as shown by the low mortality rates and the improved echocardiographic outcomes. Thus, it is important that they should be evaluated in larger studies to clarify their use in daily practice.

Review Article

Ischemic Mitral Regurgitation

Abstract

Ischemic mitral regurgitation (IMR) is a frequent complication of left ventricular (LV) global or regional pathological remodeling due to chronic coronary artery disease. It is not a valve disease but represents the valvular consequences of increased tethering forces and reduced closing forces. IMR is defined as mitral regurgitation caused by chronic changes of LV structure and function due to ischemic heart disease and it worsens the prognosis. In this review, we discuss on etiology, pathophysiology, and mechanisms of IMR, its classification, evaluation, and therapeutic corrective methods of IMR.

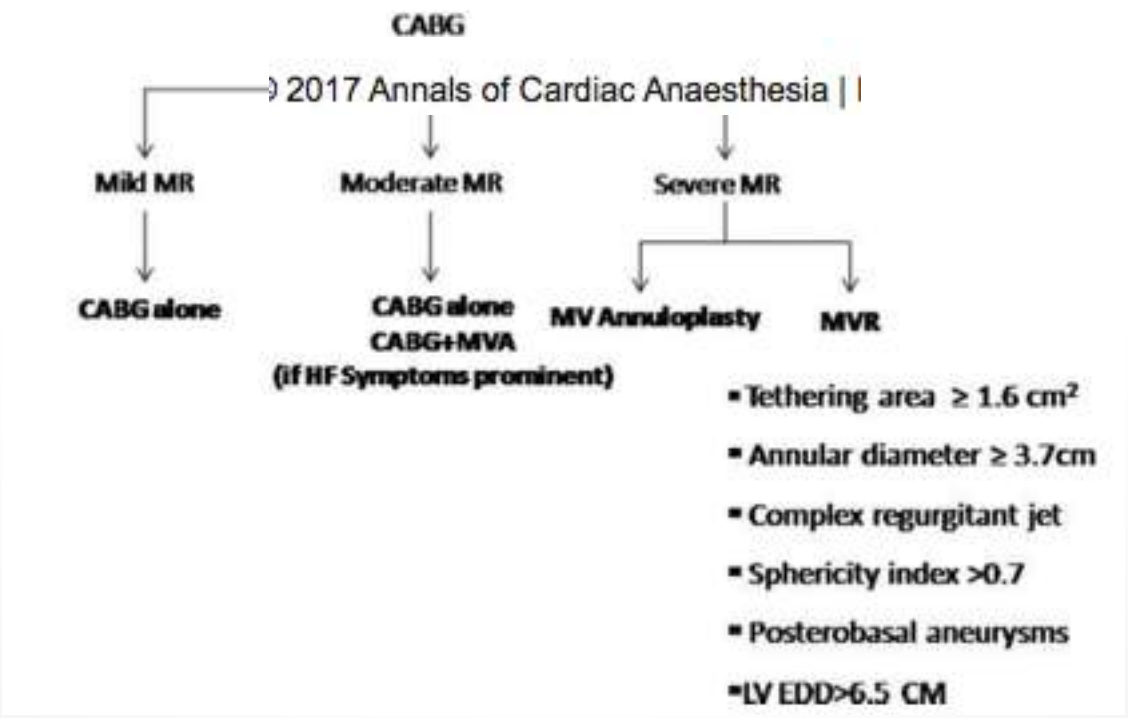
Keywords: Coronary artery disease, echocardiography, ischemic mitral regurgitation, mitral regurgitation, mitral valve repair

Praveen Kerala Varma, Neethu Krishna, Reshmi Liza Jose', Ashish Narayan Madkaiker

Division of Cardiac Surgery, Amrita Institute of Medical Sciences, Amrita Vishwa Vidyapeetham, Amrita

Annals of Cardiac Anaesthesia | Volume 20 | Issue 4 | October-December 2017

Proposed Algorithm for Surgery of IMR



Mitral valve repair versus replacement

Stephanie L. Mick, Suresh Keshavamurthy, A. Marc Gillinov

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In patients with severe IMR, the benefits of repair over replacement have been the subject of controversy. In a recent systematic review under Cochrane guidelines considering 12 studies, Rao et al. concluded that existing literature suggests that repair may be associated with improved surgical mortality and long- term survival over replacement. The authors noted that their conclusion was drawn with

considerable uncertainty given the heterogeneity of the existing studies

- mitral annular diameter 3.7 cm or greater
- with a tenting area >1.6 cm2 in the context of severe IMR is associated with annuloplasty failure in 55% of patients.

- Other risk factors for failure of repair include
- more severe left ventricular dysfunction,
- higher preoperative grade of MR,
- complex jet
- increased left ventricular sphericity
- severe leaflet tethering

In cases of severe IMR, we continue to recommend revascularization combined with undersized annuloplasty in lower risk patients (lower degrees of heart failure, elective surgery) without echocardiographic features associated with repair failure (e.g., diameter 3.7 cm or greater along with a tenting area >1.6 cm2, complex jet, lateral wall motion abnormalities).

However, in high risk patients, those with more severe heart failure, emergency cases and those with high risk features for repair failure on preoperative echo

Systematic Review

A meta-analysis of mitral valve repair versus replacement for ischemic mitral regurgitation

Sohaib A. Virk[1], Arunan Sriravindrarajah[1], Douglas Dunn[1], Kevin Liou[2], Hugh Wolfenden[3], Genevieve Tan[3], Christopher Cao[1]

[1]The Systematic Review Unit, The Collaborative Research (CORE) Group, Macquarie University, Sydney, Australia; [2]Department of Cardiology, [3]Department of Cardiothoracic Surgery, Prince of Wales Hospital, Sydney, Australia

Correspondence to: Christopher Cao. The Systematic Review Unit, The Collaborative Research (CORE) Group, Macquarie University, Sydney, Australia. Email: drchriscao@gmail.com.

Ann Cardiothorac Surg 2015;4(5):400-410

22 observational studies (n=3,815 patients) and one randomized controlled trial (n=251) were included.

MVr was associated with reduced peri-operative and late mortality compared to MVR, despite an increased recurrence of at least moderate MR at follow-up.

Keynote Lecture Series

Repair or replace for severe ischemic mitral regurgitation: prospective randomized multicenter data

Damien J. LaPar[1], Michael A. Acker[2], Annetine C. Gelijns[3], Irving L. Kron[1]

Review of Cardiothoracic Surgical Trials Network (CTSN) Trial

Both surgical approaches improve LV remodeling with reduced LVESI at 7. 12 months and are associated with similar 1-year mortality.
Higher rates of recurrent MR after MV annuloplasty are
more common among patients with preoperative evidence of
basilar LV aneurysms and/or dyskinesis. For these patients, either MV replacement or repair techniques that address
leaflet tethering may provide a more durable, long-term

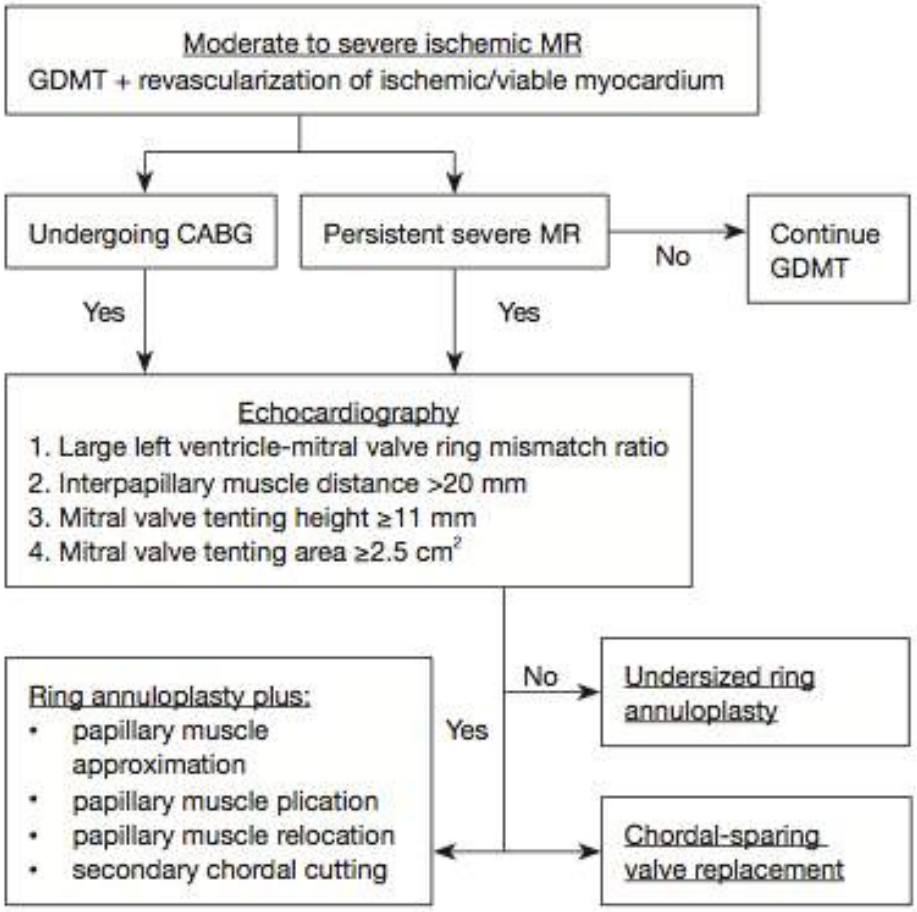
result.

Left ventricle-mitral valve ring size mismatch: understanding the limitations of mitral valve repair for ischemic mitral regurgitation

Christos G. Mihos[1], Evin Yucel[2], Orlando Santana[2]

[1]Cardiac Ultrasound Laboratory, Massachusetts General Hospital, Harvard Medical School, Boston MA, USA; [2]The Division of Cardiology at Columbia University, Mount Sinai Heart Institute, Miami Beach, FL, USA

Ann Transl Med 2017;5(1):19

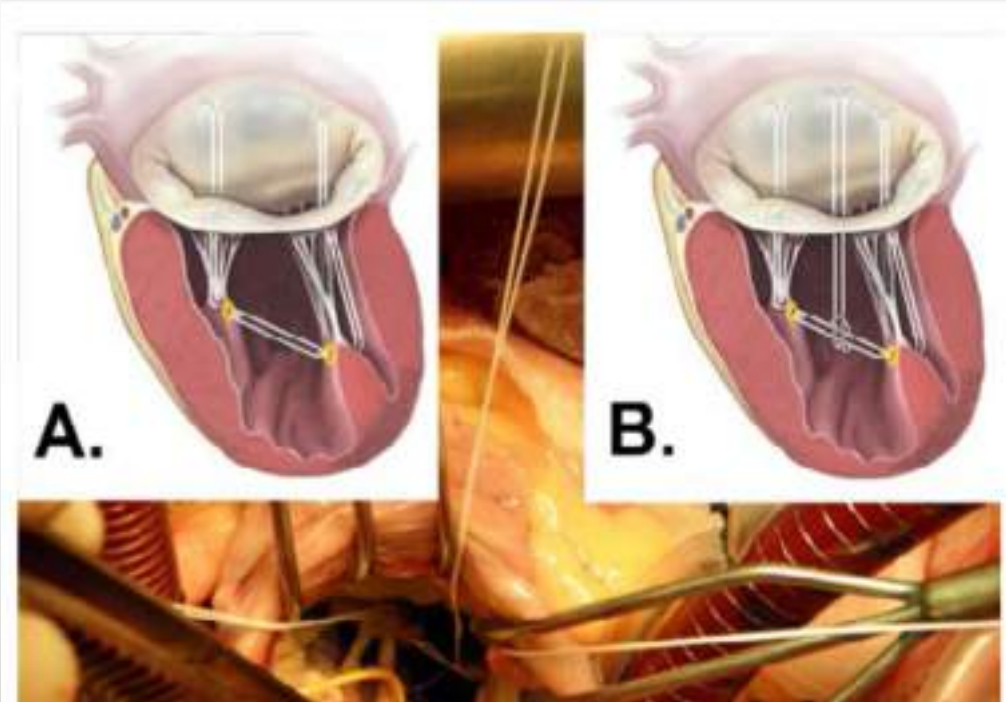


or instance, similar A2-P2 stabilizing distances can be obtained with a Carpentier Physio n. 26 (Edwards Lifesciences) or Sorin Memo 3D n. 28 (LivaNova) ring, which display 4:3 and 3:2 diameter ratios, respectively. Although implanted rings are rigid or semirigid, stiffness affects the likelihood of LV reverse remodeling and thus MR recurrence if basal segments are viable.3

Published in final edited form as:
Int J Cardiovasc Res. 2016 February 12; 5(1): . doi:10.4172/2324-8602.1000254.

Early Results of a Novel Mitral Valve Repair Procedure: The Interpapillary Polytetrafluoroethylene Bridge Formation

Nasri Alotti[1,*], **Károly Gombocz**[1], **Kiddy L Ume**[1], **Amer Sayour**[2], **Daniel Alejandro Lerman**[3,*], and **Aref Rashed**[1]



19 pts

The interpapillary PTFE bridge formation is a safe and feasible surgical procedure that is reproducible, time sparing and effectively eliminates mitral valve regurgitation with promising long-term results.

Mitral valve repair and subvalvular intervention for secondary mitral regurgitation: a systematic review and meta-analysis of randomized controlled and propensity matched studies

Christos G. Mihos[1], Steve Xydas[2], Evin Yucel[1], Romain Capoulade[1], Roy F. Williams[2], Maurice Mawad[2], Guillermo Garcia[3], Orlando Santana[4]

[1]Cardiac Ultrasound Laboratory, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA; [2]Columbia University Division of Cardiac Surgery, Mount Sinai Heart Institute, Miami Beach, FL, USA; [3]Department of Anesthesia, Mount Sinai Medical Center, Miami Beach, FL,

J Thorac Dis 2017;9(Suppl 7):

When compared with Ring only, a Ring + subvalvular MV repair is associated with greater LV reverse remodeling and systolic function, less recurrence of moderate or greater MR, and an improved geometry of the MV apparatus at short and mid-term follow-up.

Restrictive mitral valve annuloplasty versus mitral valve replacement for functional ischemic mitral regurgitation: An exercise echocardiographic study

Carlo Fino, MD,[a,c] Attilio Iacovoni, MD,[a] Paolo Ferrero, MD,[a] Michele Senni, MD,[a] Maurizio Merlo, MD,[a] Diego Cugola, MD,[a] Paolo Ferrazzi, MD,[a] Massimo Caputo, MD,[c] Antonio Miceli, MD, PhD,[c] and Julien Magne, PhD[b]

Conclusions: In patients with functional ischemic mitral regurgitation, mitral valve annuloplasty may cause functional mitral stenosis, especially during exercise.

Mitral valve annuloplasty was associated with poor exercise mitral hemodynamic performance, lack of mitral valve opening reserve, and markedly elevated postoperative exercise systolic pulmonary arterial pressure compared with mitral valve replacement.

(J Thorac Cardiovasc Surg 2014;148:447-53)

Impact of Papillary Muscle Infarction on Ischemic Mitral Regurgitation Assessed by Magnetic Resonance Imaging

Bretschneider C et al. Impact of Papillary... Fortschr Röntgenstr 2018; 190: 42–50

Key points

- No correlation between ischemic mitral regurgitation and presence of papillary muscle infarction
- Completepapillarymuscleinfarctionresultsindys function associated with ischemic mitral regurgitation
- Severity of mitral regurgitation not increased in patients with complete PM infarction

ORIGINAL RESEARCH ARTICLE

Exercise Hemodynamic and Functional Capacity After Mitral Valve Replacement in Patients With Ischemic Mitral Regurgitation

A Comparison of Mechanical Versus Biological Prostheses

Carlo Fino, MD
Attilio Iacovoni, MD
Philippe Pibarot, DVM, PhD
John R. Pepper, MChir
Paolo Ferrero, MD
Maurizio Merlo, MD
Lorenzo Galletti, MD
Massimo Caputo, MD
Paolo Ferrazzi, MD

Circ Heart Fail. 2018;11

WHAT IS NEW?

- In patients with ischemic mitral regurgitation, mitral valve replacement with a mechanical valve was associated with better improvement in mitral valve hemodynamics (larger effective orifice areas and lower gradients) and patient's functional capacity as reflected by the larger increase in 6-minute walking test distance.
- Prosthesis-patient mismatch has a detrimental impact on the hemodynamic and functional out- comes of patients with ischemic mitral regurgita- tion undergoing mitral valve replacement.