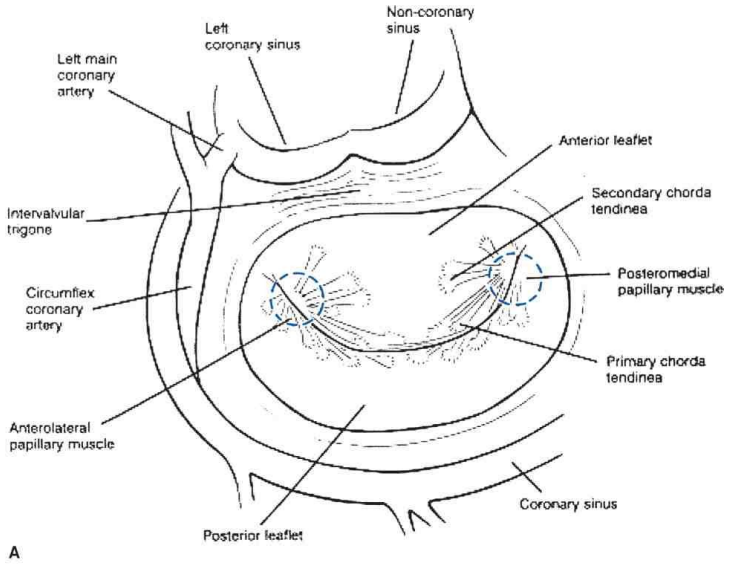
Mitral valve
Repair vs Replacement

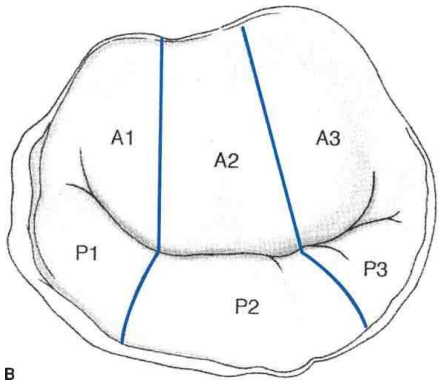
Sotiris Papaspyros 18/05/2009

Historical facts

- Early era focused on mitral stenosis created by rheumatic heart disease.
- Sir Thomas Lauder Brunton, a Scottish physician, first introduced the concept of surgical repair of the mitral valve in 1902.
- 1923 Elliot Cutler, the future Moseley Professor of Surgery at the Peter Bent Brigham Hospital in Boston, performed the world's first successful mitral valve operation by carrying out a transventricular commissurotomy with a neurosurgical tenotomy knife. Cutler had worked assiduously on this problem in the Surgical Research Laboratories of Harvard Medical School before turning his attention to a critically ill, bedbound 12-year-old girl, performing mitral valvulotomy on May 20, 1923. Subsequent attempts at transventricular valvulotomy with a cardiovalvutome to produce graded mitral regurgitation resulted in several deaths and Cutler eventually abandoned the procedure.
- Henry Souttar of England performed a single successful transatrial finger commissurotomy in 1925, but received no further referrals.
- After Souttar there remained little activity in mitral valve repair until Dwight Harken, then the Chief of Cardiothoracic Surgery at the Peter Bent Brigham Hospital, published his groundbreaking series of valvuloplasty patients for mitral stenosis along with Charles Bailey in Philadelphia.
- Surgical treatment of mitral regurgitation for prolapse was first introduced in the 1950s but with limited success. Later, in the '60s, '70s, and '80s, the visionary concepts and ideas first disseminated by Carpentier and Duran, stimulated the field.

Anatomy (Form follows function)

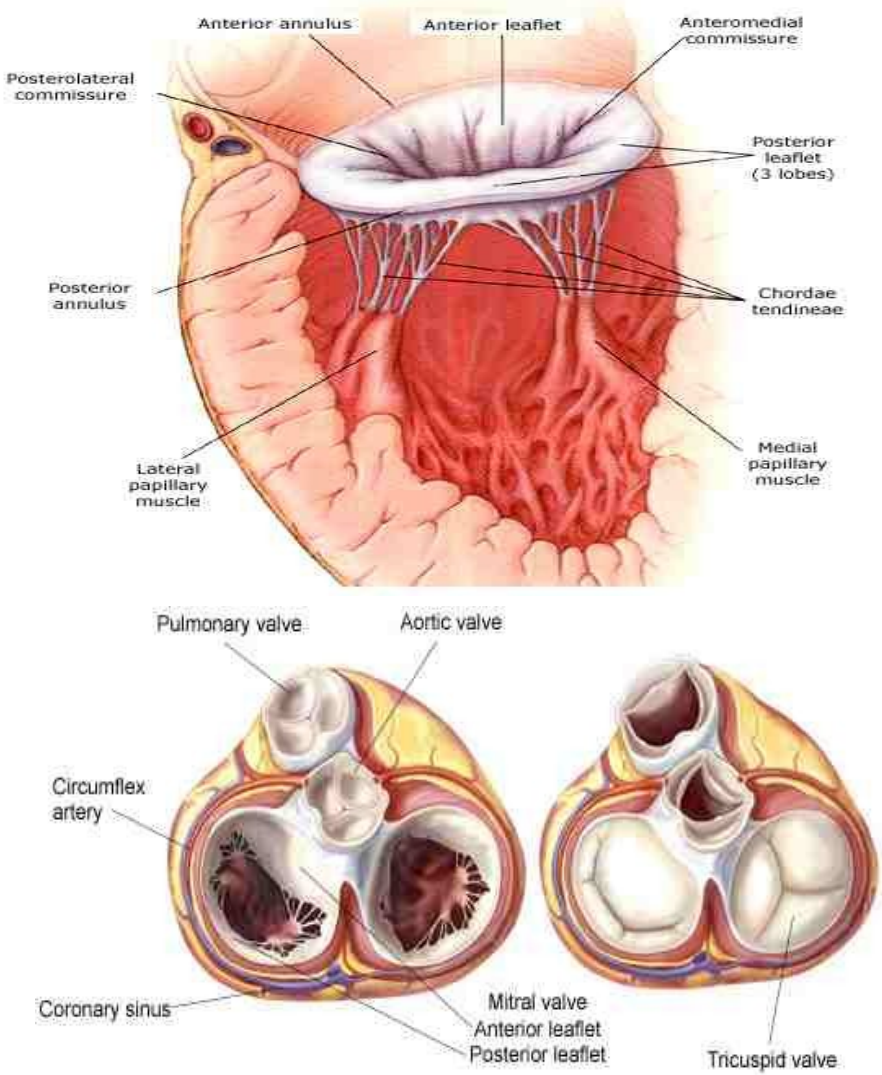




Panel A depicts critical structures that the cardiac surgeon must recognize, including the circumflex coronary artery, the coronary sinus, the atrioventricular node, and aortic root. Note that the left and right trigones are superior to the commissures.

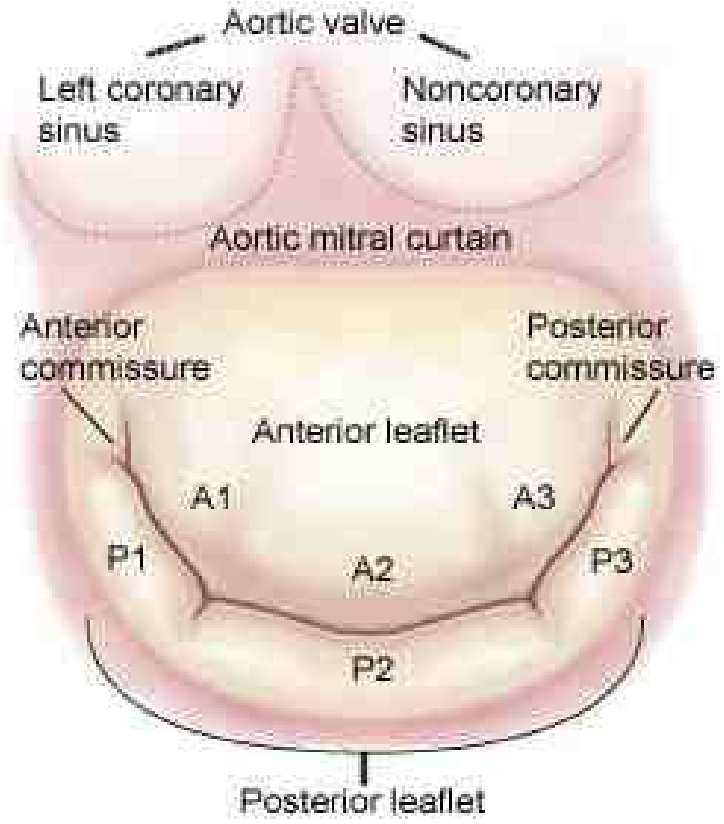
Panel B depicts the conventional terminology used to describe the pathoanatomic parts of the anterior and posterior leaflets.

Relations



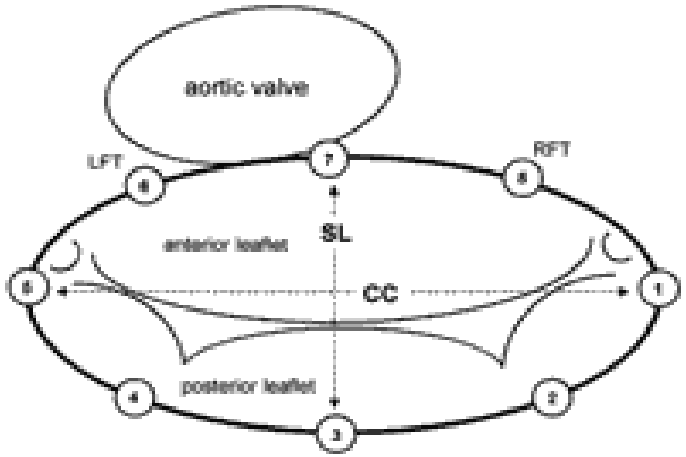
- If one part of the valvular apparatus fails, regurgitation results. five discrete components to the mitral valve complex:
  1. the annulus,
  2. the two leaflets (anterior and posterior),
  3. the chordae,
  4. the papillary muscles, and
  5. the left ventricle itself.
- The annulus is surrounded by vitally important structures that the cardiac surgeon must avoid for safe surgery:
  - the circumflex coronary artery laterally,
  - the coronary sinus medially,
  - the aortic root superiorly, and
  - the atrioventricular node superior-medially.

Mitral valve leaflets

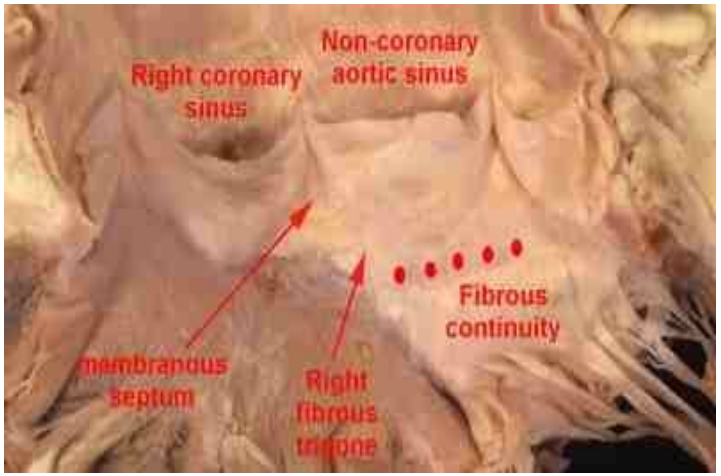


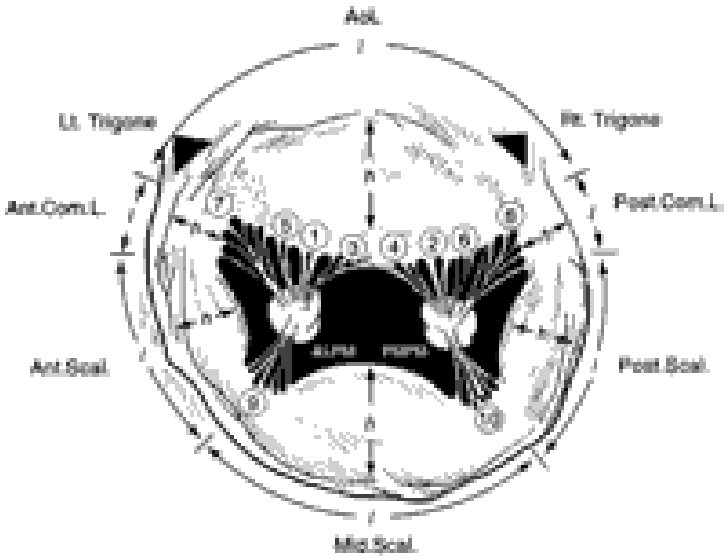
- The anterior leaflet of the mitral valve (AML) is in continuity with the left and noncoronary cusps of the aortic valve and is located directly beneath the left ventricular outflow tract (LVOT). It typically accounts for approximately 40% of the circumference.
- The posterior mitral valve leaflet (PML) is crescent-shaped and dilates more commonly in degenerative disease.
- For surgical decision making and analysis, both the anterior and posterior leaflet are divided into three parts, corresponding to the typical three scalloped areas of each leaflet (A1, A2, A3 for the anterior leaflet; P1, P2, and P3 for the posterior leaflet; 1 refers to the leftmost, or lateral scallop; 2 the middle scallop; and 3 the rightmost, or medial scallop;

Fibrous trigones

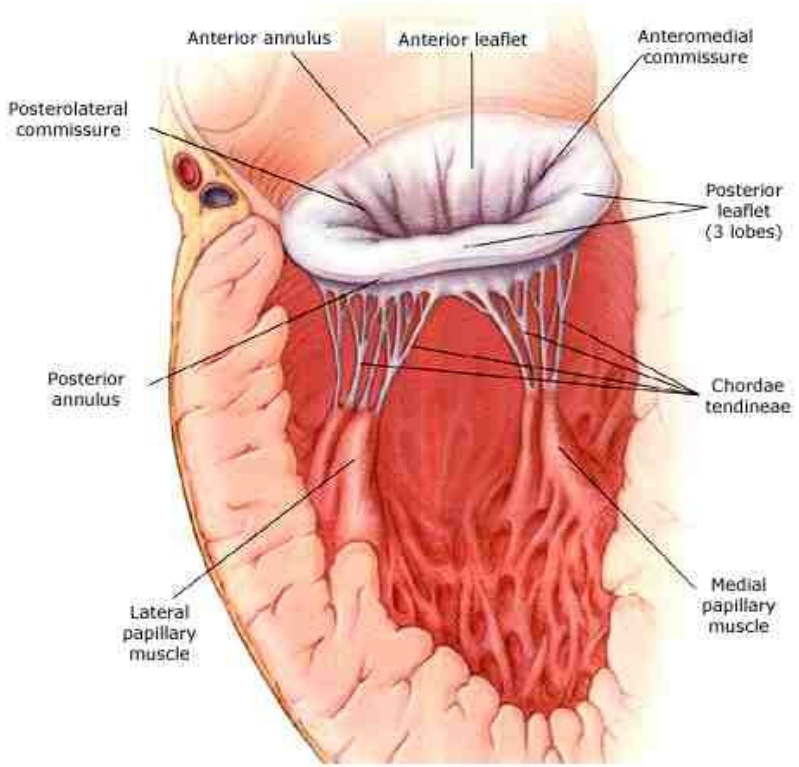


Of critical importance to the surgeon are the right and left fibrous trigones. These are intimately related to the anterior annulus and are contiguous with the aortic valve curtain and must be identified during surgery. The trigone points form anchoring points for ring annuloplasty.





Papillary muscles



- There are two papillary muscles, the anterolateral and the posteromedial. Each muscle is attached to the leaflets by the chordae tendinae.
  - Primary chords are those that attach to the edge of the leaflet.
  - Secondary chords are those that attach to the underside of the leaflet.
  - Tertiary chords (only the posterior leaflet has tertiary chords) are those that attach to the undersurface of the leaflet directly from the ventricular wall instead of from the papillary muscle.
- The papillary muscles each give off chordae to both leaflets and correspond to the anterolateral and posteromedial commissures of the mitral valve.
- The anterolateral papillary muscle receives blood from both the LAD as well as the Cx
- The posteromedial one receives blood usually from only the PDA or a branch of the Cx. Because of its single coronary blood supply, the posteromedial papillary muscle is more susceptible to infarction and rupture than the anterolateral one.

Aetiology

Mitral regurgitation

- Myxomatous degeneration
- Ischaemic
- Rheumatic
- Endocarditis
- Other
  - Marfan
  - Trauma

Mitral stenosis

- Rheumatic
- Congenital

Pathophysiology of myxomatous degeneration

- A defect in the fibroelastic connective tissue of the valvular leaflets, chordae, and annulus. The myxomatous defect leads to an abnormal elongation and redundancy of valve tissue and chordae.
  - Annular dilatation obliterates the normal coaptation line between the anterior and posterior leaflet, causing regurgitation.
  - Leaflet redundancy results in a movement of the redundant leaflet into the left atrium during diastole.
  - Elongation of the chordae also causes leaflet tissue to move into the atrium during diastole, also resulting in compromised coaptation.
  - Ruptured or flail leaflets are often the result of systolic stresses fracturing weakened chordae, causing severe regurgitation.
- Mitral regurgitation represents pure volume overload for the left ventricle.
  - In myxomatous disease, MR is typically of the chronic compensated variety.
  - A vicious circle is perpetuated whereby the excess volume load over time results in ventricular failure.
  - Ventricular failure itself implies ventricular dilatation, which results in a greater degree of MR. Thus, MR begets more MR, so a vicious downward spiral is created.
  - MR created by left ventricular failure occurs primarily by ventricular dilatation. Successful repair will result in left ventricular mass reduction.

Indications for surgery

Mitral regurgitation

- Severe MR (TOE,TTE) with or without symptoms before onset of:
  - LV impairment (EF<60%)
  - AF,
  - pulmonary hypertension

Mitral stenosis

- NYHA III/IV
- Systemic embolism (despite anticoag.)
- Severe MS (<1.5 cm^2)
- AF, pulmonary venous congestion, pending pregnancy

Mitral regurgitation

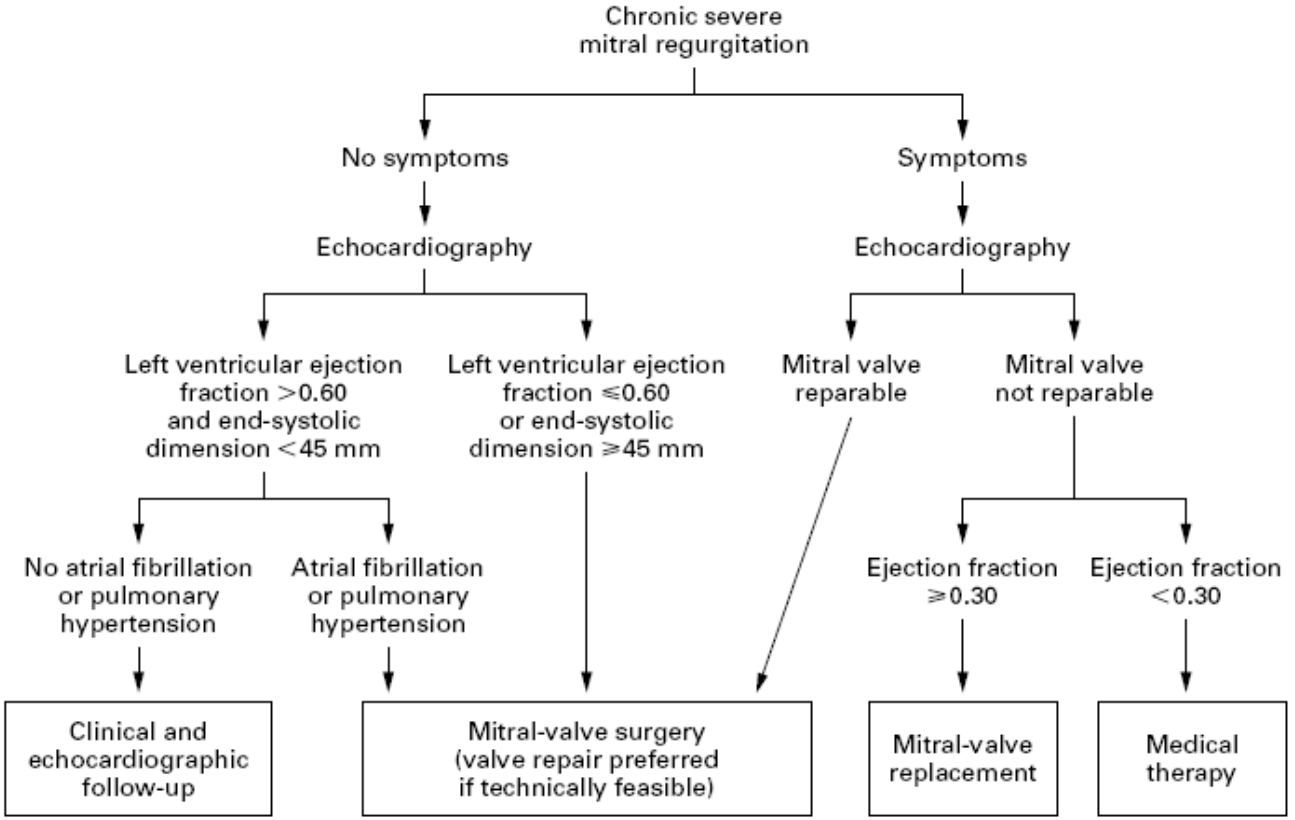


Figure 3. Management of Chronic Severe Mitral Regurgitation.
Modified from the American College of Cardiology–American Heart Association guidelines.[18]

N Engl J Med, Vol. 345, No. 10 September 6, 2001
CATHERINE M. OTTO M.D.

Quantitative Determinants of the Outcome of Asymptomatic Mitral Regurgitation

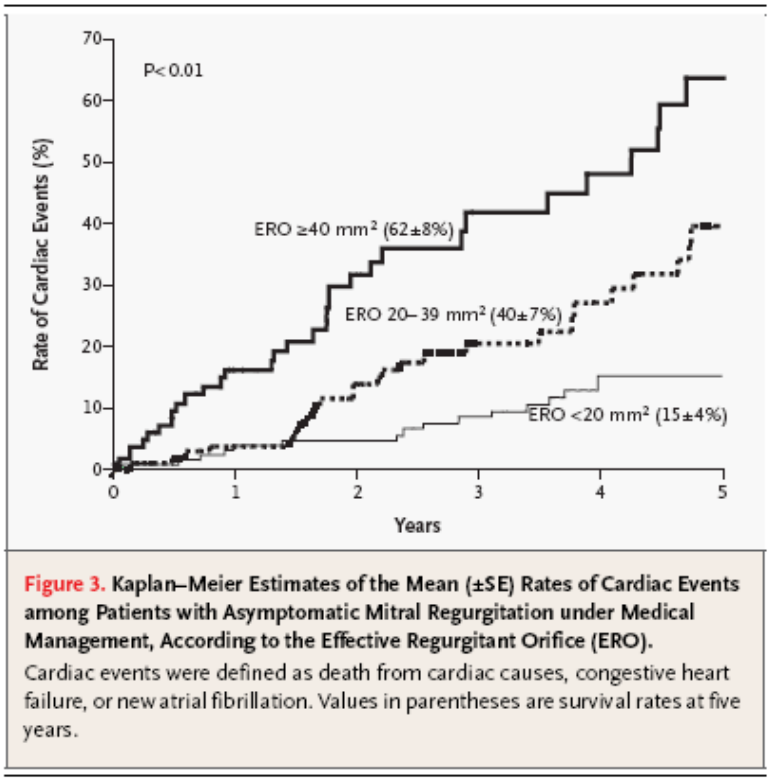


Figure 3. Kaplan–Meier Estimates of the Mean (±SE) Rates of Cardiac Events among Patients with Asymptomatic Mitral Regurgitation under Medical Management, According to the Effective Regurgitant Orifice (ERO).
Cardiac events were defined as death from cardiac causes, congestive heart failure, or new atrial fibrillation. Values in parentheses are survival rates at five years.

According to published guidelines
mitral regurgitation:
Regurgitant volume
Mild <30ml/beat
Moderate 30-59ml/beat
Severe >60ml/beat
effective regurgitant orifice of less than
Mild <20 mm^2,
Moderate 20 to 39 mm^2
Severe > 40 mm^2

conclusions

Quantitative grading of mitral regurgitation is a powerful predictor of the clinical outcome of asymptomatic mitral regurgitation. Patients with an effective regurgitant orifice of at least 40 mm^2 should promptly be considered for cardiac surgery.

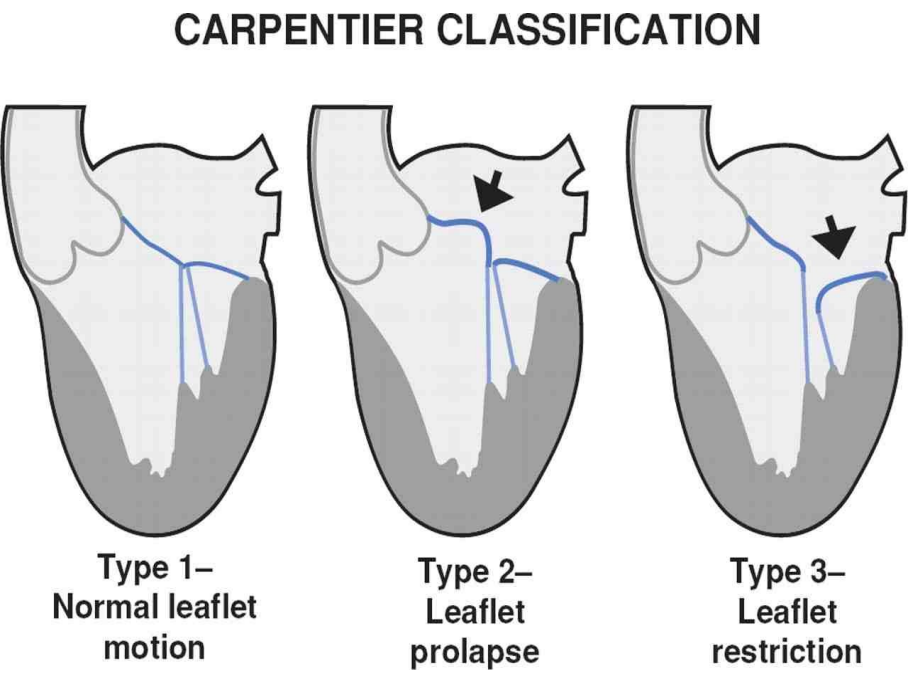
N Engl J Med 2005;352:875-83. Maurice Enriquez-Sarano, Mayo Clinic,

MV repair approach

- (L.Cohn, F. Chen) overall philosophy and technique is as follows:
  1. Expose the valve well through the complete development of the Sondergaard groove, division of pericardial attachments of the superior and inferior venae cavae.
  2. Assess the valve through saline injection and corroborate the intraoperative findings with transesophageal echocardiography.
  3. Perform basic, obvious leaflet repair procedures first (e.g., quadrangular resections to the posterior leaflet).
  4. Implant the annuloplasty ring sized by the height of the anterior leaflet (not the trigones or commissures).
  5. Test the repair.
  6. Perform additional reparative procedures as needed.

  – With the above maneuvers, we estimate that approximately 90% of all degenerative valves can be repaired.
  – Cardiac anesthesia colleagues are essential in utilizing the invaluable tool of TOE monitoring for pre and postrepair assessment.

Operative assessment



- Type I Annular dilatation/leaflet perforation
- Type II Papillary muscle or chordal elongation rupture
- Type III
  - IIIa-restricted opening
  - IIIb-restricted closure

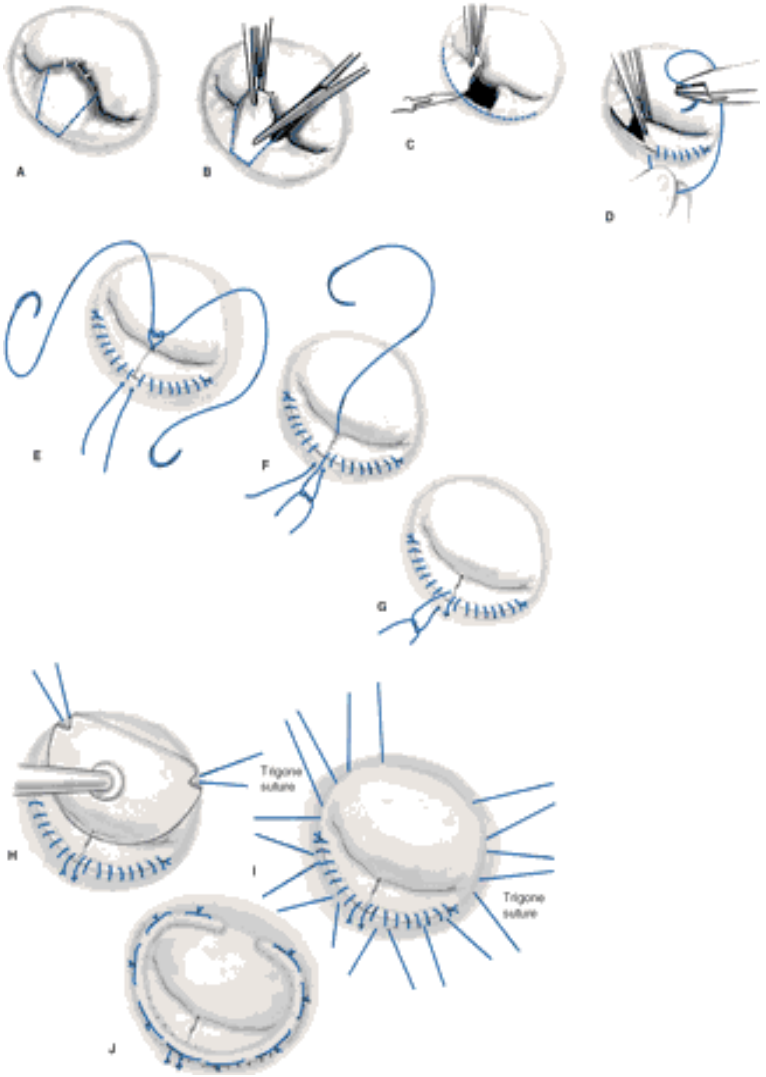
Principles of repair

- Reduce or obliterate the enlarged posterior segments and reduce the overall height of the posterior leaflet to prevent systolic anterior motion of the anterior leaflet.
  - In general, the height of the posterior leaflet should be no more than 1 to 1.5 cm in average-sized patients once the repair is complete.
  - The resulting repair should result in a coaptation line at the level of the annulus during systole
- A remodeling annuloplasty ring is essential for all repairs.

Repair techniques

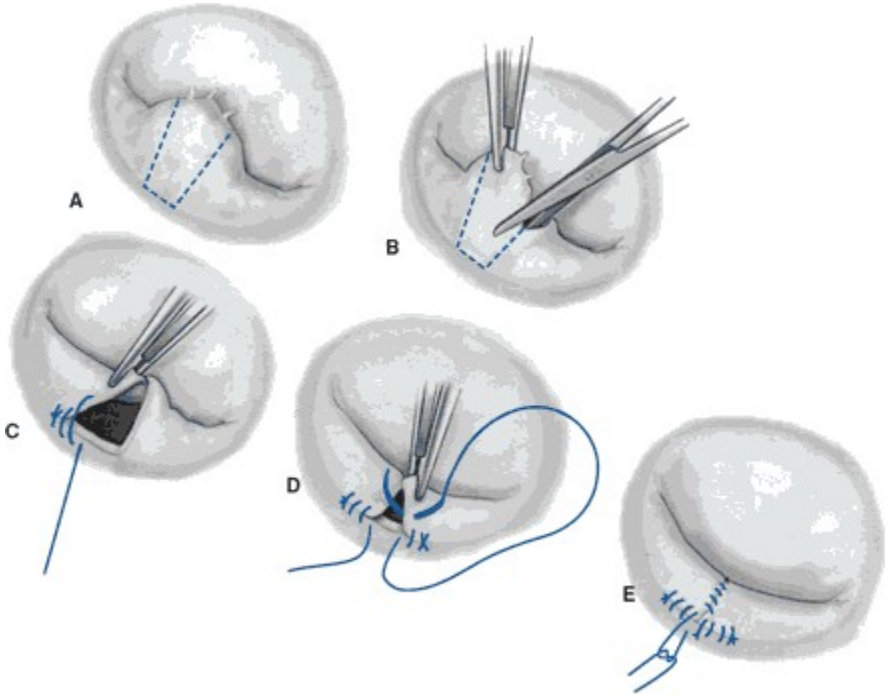
- **Posterior Leaflet Quadrangular Resection**
- **Commissural Prolapse**
- **Anterior Leaflet Prolapse**
  - Chordal shortening by implantation into papillary muscles
  - Artificial chordae
  - Chordal transfer
  - Edge-to-edge technique

Posterior Leaflet Quadrangular Resection



- Panel A demonstrates the classic flail P2 segment.
- Panel B demonstrates resection of this flail segment.
- Panels C and D demonstrate the classic sliding valvuloplasty and advancement, in which each segment of the valve adjacent to the resected P2 segment is separated from the annulus. The valve is then reattached with the gap eliminated. At the same time, the height of the posterior leaflet is reduced.
- Panels E, F, and G demonstrate completion of the classic sliding valvuloplasty.
- Panels H, I, and J illustrate placement of the annuloplasty stitches and ring placement. Sizing of the ring is done by the size of the anterior leaflet.

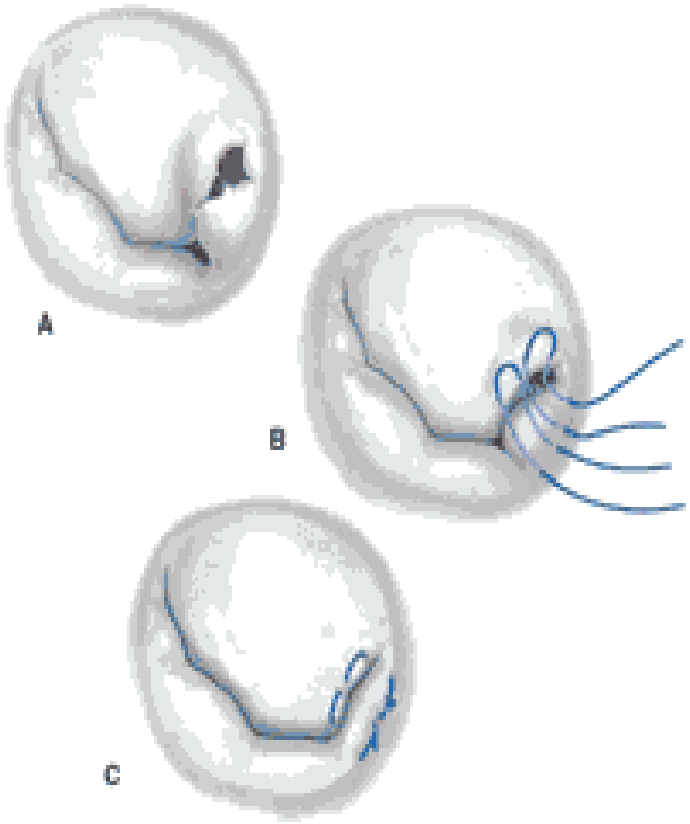
Posterior Leaflet Quadrangular Resection



The fold-over leaflet advancement.

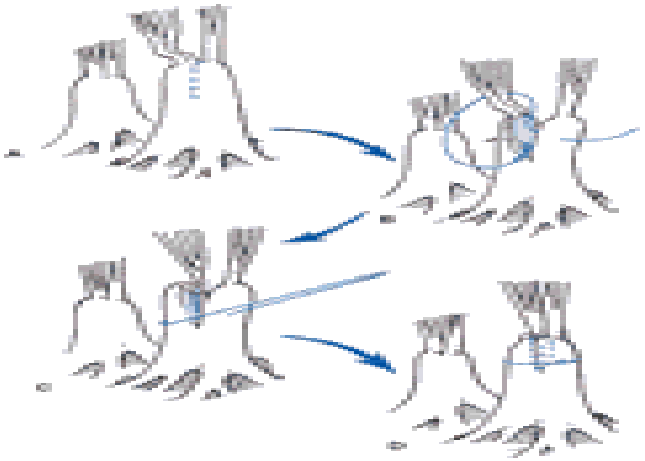
- After resection of the flail P2 segment (panel B), the cut edges of each side of the resulting gap are sewn to the annulus as they are "folded down." This is done for each side of the gap for half of the original height of each side.
- The top halves are then sewn together (panel E).
- The result is that the leaflet gap is eliminated and the height of the leaflet reduced.

Commissural Prolapse

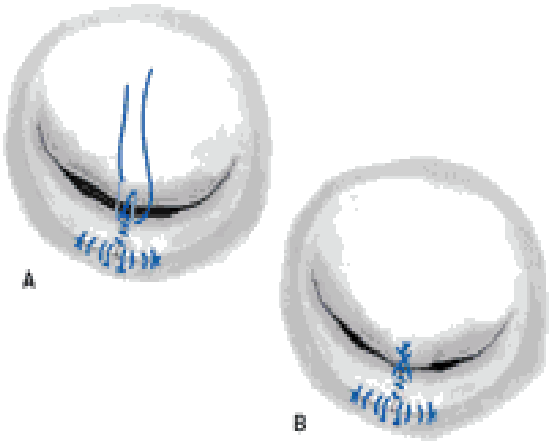


Commissuroplasty. Simple horizontal mattress stitches placed in the ruptured commissure eliminate regurgitation without need for further leaflet resection, even with ruptured chordae.

Anterior Leaflet Prolapse

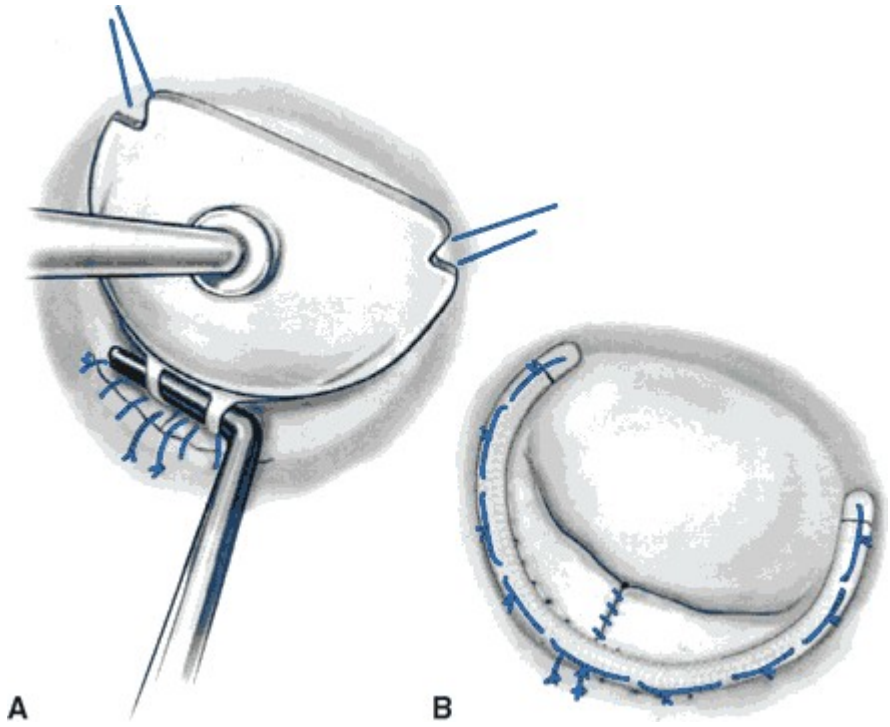


Anterior leaflet chordal shortening. The papillary muscle is incised and the redundant chord folded into it. The excess chord is held in place with pledgeted sutures.



Edge-to-edge technique. The technique involves a braided polyester figure-of-eight stitch at apposition of A2 and P2.

Ring annuloplasty sizing and insertion



- The ring for degenerative disease should be slightly oversized.
- Sizing should be done to match the height of the anterior leaflet, not the distance between the trigones or commissures.
- Nine to eleven mattress sutures are usually needed.

Results*

	Repair	Replacement
Operative mortality	<4%	5%-9%
5 year survival	83 %	69 %
10 year survival	68 %	52 %
Freedom from reoperation 10 years	93 %	80 %
Freedom from thromboembolism 10 years	68 %	70%

*Key topics in cardiac surgery (Eric Lim, Francis Wells, Papworth) Pub. 2005

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Survival Advantage and Improved Durability of Mitral Repair for Leaflet Prolapse Subsets in the Current Era (myxomatous degeneration)

Table 2. Cumulative Mortality Overall

Endpoint	30 Day %(n)	5 Year %(n)	10 Year %(n)	15 Year %(n)	*p* v Repair
Cumulative Mortality					
Expected	0.2	13.5	28.4	44.6	NA
Overall	1.5 (1344)	13.6 (899)	32.9 (320)	60.9 (70)	NA
Repair	0.7 (1129)	11.3 (766)	29.4 (249)	58.5 (42)	NA
Replacement	5.6 (215)	25.4 (133)	47.5 (71)	70.7 (28)	<0.0001

n = number of patients; NA = not applicable.

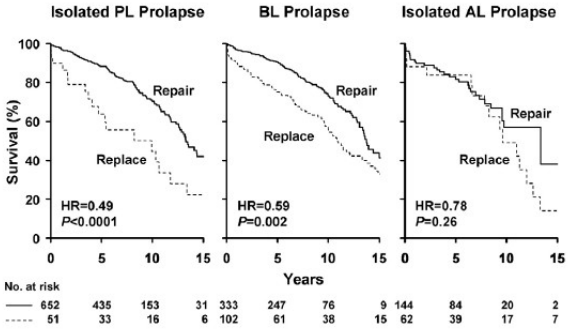


Fig 1. Probability of survival (death from any cause) among patients having mitral valve repair versus replacement divided into leaflet prolapse groups. Zero time on abscissa represents time of surgery and numbers at the bottom indicate patients at risk. (solid line = repair; broken line = replacement; AL = anterior leaflet; BL = bileaflet; HR = hazard ratio for survival of replacement group compared with repair group; PL = posterior leaflet.)

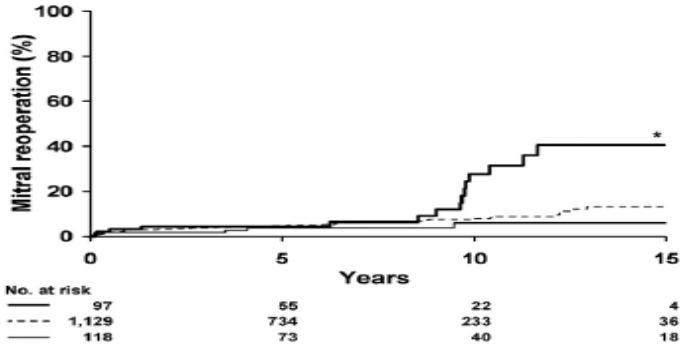


*Fig 2. Probability of reoperation (mitral specific) after mitral valve repair versus replacement (biological or mechanical prosthesis). Zero time on abscissa represents date of operation and numbers at the bottom of the figure represent patients at risk. (Heavy solid line = biological prosthesis, HR = 2.4, *p = 0.0016; light solid line = mechanical prosthesis, HR = 0.7; broken line = repair; HR=hazard ratio for reoperation compared with repair group.)*

(Ann Thorac Surg 2006;82:819 –27) Mayo Clinic College of Medicine, Rochester, Minnesotak

Rakesh M. Suri, Hartzell V. Schaff, Joseph A. Dearani, Thoralf M. Sundt, III, RichardC. Daly, Charles J. Mullany, Maurice Enriquez-Sarano and Thomas A. Orszulak

Table 4. Multivariate Predictors of Reoperation

Variable	HR	95% CI	*p*
Overall			
CABG	1.6	1.0–2.4	0.05
Prolapse AL vs PL	4.7	2.7–8.0	<0.0001
Prolapse BL vs PL	2.5	1.5–4.1	0.0006
Predischarge MR	3.5	NA	<0.0001
Repair			
Age	0.9	0.96–0.99	0.04
CABG	1.9	1.1–3.2	0.014
Prolapse AL vs PL	2.0	1.1–3.8	0.023
Predischarge MR > mild	4.4	2.7–7.1	<0.0001
Leaflet resection	0.5	0.3–0.8	0.008
Chordal shortening/transfer	2.3	1.2–4.1	0.009
Annuloplasty - none	3.9	1.5–10.0	0.005
Annuloplasty -commissural	2.7	1.4–5.2	0.03
Replacement			
Biological vs mechanical	4.0	1.6–10.7	0.004

AL = anterior leaflet; BL = bileaflet; CABG = coronary artery bypass; CI = confidence interval; HR = hazard ratio; MR = mitral regurgitation; NA = ; PL = posterior leaflet.

Table 3. Multivariate Predictors of Mortality Overall

Variable	HR	95% CI	*p*
Age	1.08	1.06–1.09	<0.001
NYHA class	1.44	1.23–1.64	<0.001
CABG	1.56	1.27–1.92	<0.001
Replacement vs Repair	1.46	1.17–1.82	<0.001
Preop EF	0.98	0.97–0.99	<0.001
Preop LVESD	1.02	1.00–1.03	0.05

CABG = coronary artery bypass; CI = confidence interval; EF = ejection fraction; HR = hazard ratio; LVESD = left ventricular end systolic dimension; NYHA = New York Heart Association; preop = preoperative.

Conclusions.

- **Mitral repair affords superior long-term survival, with permanence comparable with mechanical valve replacement.**
- **In all categories of mitral leaflet prolapse, durability of valve repair has improved over the past decade.**

MITRAL VALVE REPAIR AND REPLACEMENT FOR RHEUMATIC DISEASE

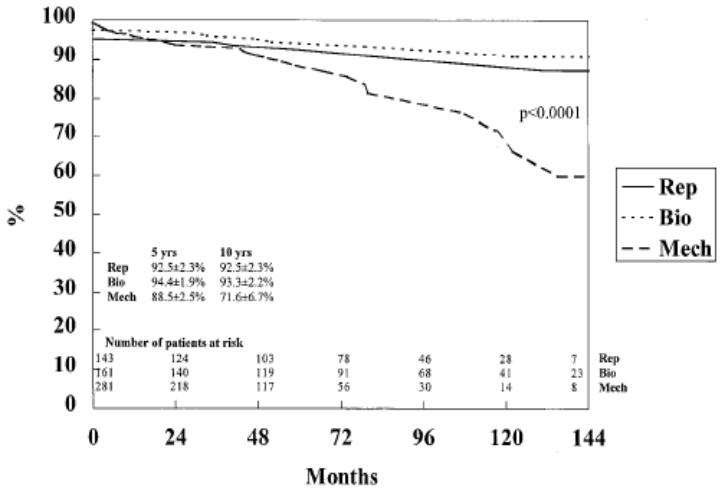
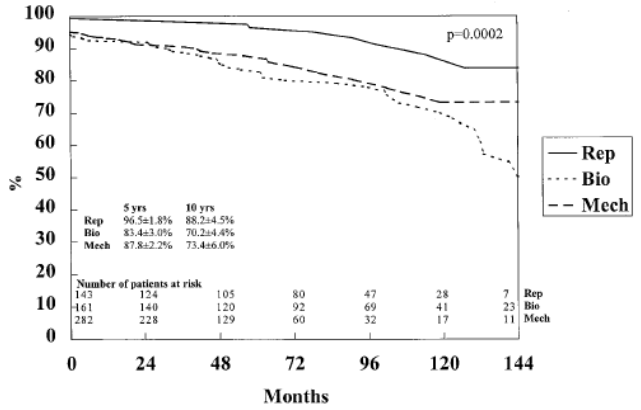


Fig 5. Freedom from thromboembolic events in 573 patients undergoing mitral valve surgery for rheumatic disease. *Rep,* Valve repair; *Bio,* bioprosthetic valve replacement; *Mech,* mechanical valve replacement.



g 1. Survival in 573 patients undergoing mitral valve surgery for rheumatic disease. *Rep,* Valve repair; *Bio,* bio-osthetic valve replacement; *Mech,* mechanical valve replacement.

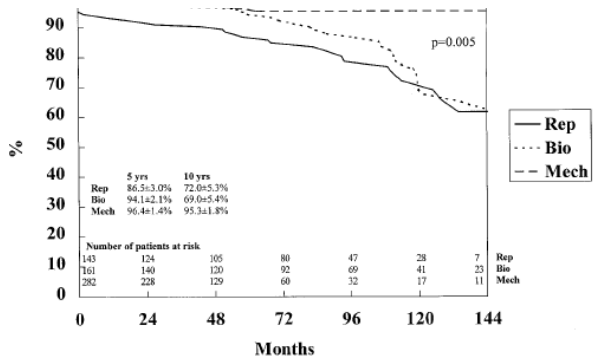


Fig 4. Freedom from reoperation in 573 patients undergoing mitral valve surgery for rheumatic disease. *Rep,* Valve repair; *Bio,* bioprosthetic valve replacement; *Mech,* mechanical valve replacement.

Conclusions:

- **Mechanical valves minimize reoperation but limit survival and increase thromboembolic complications.**
- **Patients undergoing valve repair had improved late cardiac survival independent of their preoperative characteristics.**
- **Rheumatic mitral valves should be repaired when technically feasible, accepting a risk of reoperation, to maximize survival and reduce morbidity**

Toronto General Hospital, University Health Network, Department of Surgery,University of Toronto, Toronto, Ontario, Canada. **(J Thorac Cardiovasc Surg 2000;119:53-61)**
Mitral valvuloplasty, a better alternative Comparative study between valve reconstruction and replacement for rheumatic mitral valve disease M. J. Antunes
Departments of Cardiothoracic Surgery, University of Witwatersrand, Johannesburg, South Africa, and University of Coimbra, Portugal

Is Mitral Valve Repair Superior to Replacement in Elderly Patients?(>75)

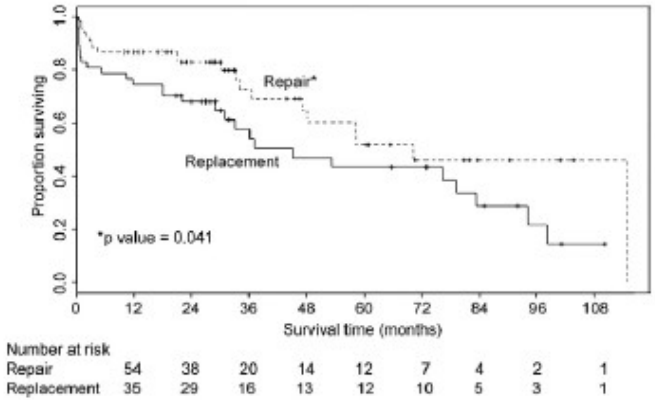


Fig 1. Long-term survival with mitral valve repair (dashed line) versus replacement (solid line) in elderly patients.

Table 3. Operative and Mortality Outcomes for Repair Versus Replacement, Stratified by Patient Age Group

	≥75 Years Old			<75 Years Old		
Variable	Replacement (n = 47)	Repair (n = 70)	*p* Value	Replacement (n = 98)	Repair (n = 100)	*p* Value
Conversion to MV replacement/return to CPB for MR[a]	0 (0%)	1 (2.8%)	0.40	0 (0%)	1 (1.0%)	1
30-day mortality	11 (23.4%)	5 (7.1%)	0.01	5 (5.1%)	2 (2%)	0.27
Postoperative complications	15 (31.9%)	13 (18.6%)	0.10	17 (17.3%)	13 (13%)	0.39
Stroke	6 (12.8%)	0 (0%)	0.003	7 (7.1%)	5 (5%)	0.55
Acute renal failure	8 (17.0%)	3 (4.3%)	0.03	6 (6.1%)	2 (2%)	0.17
Infectious complication	8 (17.0%)	4 (5.7%)	0.06	7 (7.1%)	6 (6%)	0.68
Pneumonia	4 (8.5%)	8 (11.4%)	0.76	4 (4.1%)	2 (2%)	0.44
Myocardial infarction	0 (0%)	0 (0%)		1 (1.0%)	0 (0%)	1
Prolonged course on ventilator (>3 days)	10 (21.3%)	2 (2.9%)	0.001	7 (7.1%)	7 (7%)	0.97
Prolonged ICU stay (>3 days)	10 (21.3%)	3 (4.3%)	0.004	13 (13.3%)	7 (7%)	0.14
Postoperative hospital stay (days)[b]	14.0 ± 13.2	8.6 ± 3.5	0.01	11.4 ± 9.2	8.5 ± 7.1	0.02

[a] Categorical variables are reported as N (%); *p* values derived from χ^2 test or Fisher's exact test. [b] Continuous variables are reported as mean ± standard deviation; *p* values derived from Student's *t* test.

CPB = cardiopulmonary bypass; ICU = intensive care unit; MR = mitral regurgitation; MV = mitral valve.

Conclusions.

- **In patients age 75 years or older, mitral repair is associated with a lower risk of mortality, postoperative stroke, and prolonged intensive care unit and hospital stay compared with mitral replacement.**
- **Mitral repair can be performed in preference over replacement even in patients older than the age of 75.**

(Ann Thorac Surg 2008;86:77– 86) University of Virginia, Charlottesville, Virginia
Gorav Ailawadi, Brian R. Swenson, Micah E. Girotti, Leo M. Gazoni,

Mitral valve repair in patients over the age of 70 years H Azar and S Szentpetery *Eur J Cardiothorac Surg* 1994;8:298-300

Mitral valve disease: if the mitral valve is not reparable/failed repair, is bioprosthesis suitable for replacement?

Background: The reparability of mitral valve pathology has been reported in large published series to be well greater than 90%.
However, the Society of Thoracic Surgeons national database reported the reparable rate to be 40.5% in 2000 and increased to only 58% in 2006.1 It is due to this data that the prosthesis-type choices for non-reparable and failed repairs of mitral valves requires consideration.
Discussion: As one considers the risk of reoperation with bioprostheses to replace a non-reparable mitral valve, the choice for mitral valve replacement in the age category at risk (51-60 years) is mechanical prostheses.
It is only if the age category is above 70 years should one consider bioprostheses.

Conclusions: The CE-SAV mitral porcine bioprosthesis cannot be recommended as representative prosthesis-type of choice for non-reparable or failed repair of native mitral valves for ages <70 years.
The CE-SAV mitral porcine bioprosthesis is satisfactory for implantation >70 years of age. The clinical performance of the CE-SAV is similar to other mitral bioprostheses.

University of British Columbia, Vancouver, Canada
Eur J Cardiothorac Surg 2009;35:104-110

Meta-analysis of clinical outcomes following surgical mitral valve repair or replacement

Table 3
Meta-analysis results for total survival outcome, comparing repair to replacement, using mixed model, adjusting for etiology

Etiology	Studies (*n*)	Estimated hazard ratio[a]	95% confidence interval[a]	Favors	Heterogeneity test *p*-value
Chords	1	1.23	(0.38, 4.04)	–	–
Degenerative/myxomatous	4	1.68	(1.39, 2.02)	Repair	0.82
Ischemic	4	1.18	(0.83, 1.69)	–	0.38
Mixed	10	1.49	(1.24, 1.78)	Repair	0.21
Rheumatic	2	2.33	(1.59, 3.43)	Repair	0.58
Summary	21	1.58	(1.41, 1.78)	Repair	0.23

[a] Hazard ratios and confidence limits are computed as ratios of hazards of all-cause death for replacement relative to repair.

Conclusion

- The systematic meta-analyses reported in this study indicate some strong support for repair relative to replacement surgery in patients with non-ischemic mitral valve disease. For ischemic mitral repair, there was a trend toward a lower 30-day mortality that did not achieve statistical significance.
- No difference in total mortality was observed between repair and replacement of ischemic mitral valve long term.
- Repair does appear to have a lower risk of development of thromboembolism. However, treatment related differences in the risk of re-operation remain uncertain and await further longitudinal comparison research studies or trials.
- Because the etiology of mitral valve disease is the predominant predictor of the outcome of treatment, documentation of the etiologic categories and modality of surgical therapy should be more comprehensive and detailed to attempt to reduce the current limitations in future publications.

Jeffrey Shuhaiber and Robert J. Anderson ***Eur J Cardiothorac Surg*** **2007;31:267-275**
Loyola University Stritch School of Medicine, Department of Thoracic and Cardiovascular Surgery, Maywood, IL 60153, United States
b Division of Epidemiology and Biostatistics, University of Illinois at Chicago, Chicago, IL 60612, United States

Long-term outcome after mitral valve repair: a risk factor analysis

Table 4
Independent risk factors of late death and reoperation at multivariate analysis

Multivariate analysis	*p*-value	Risk ratio	95% confidence interval
Late deaths			
Residual NYHA	0.001	4.55	1.85–14.29
Preoperative EF	0.013	1.09	1.02–1.18
Etiology functional	0.018	4.17	1.32–16.67
Etiology ischemic	0.049	3.13	1.01–10.0
Reoperations			
7 POD residual MR	0.005	4.55	1.56–20.0
Age <60 years	0.012	8.7	2.44–37.8
Valvuloplasty (absence of ring)	0.034	4.76	1.79–33.3

EF: ejection fraction; 7 POD MR: seventh postoperative day mitral regurgitation.

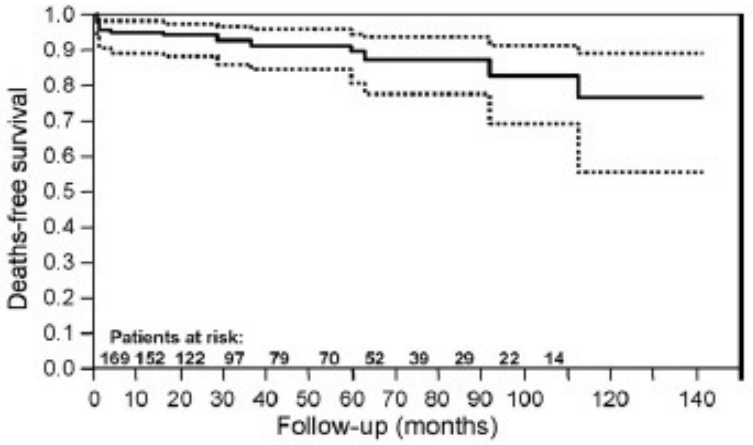


Fig. 2. Actuarial global survival. Survival freedom from early and late deaths.

The overall mortality was 12.6% (22/175). Six patients had died perioperatively which left 169 patients for long-term follow-up. There were 16 late deaths (9.1%). Kaplan—Meier actuarial analysis showed a 96 1% 1-year survival, 88 3% 5-year survival and a 69 8% 10-year survival. Most patients who died were in NYHA class III and IV and 75% were cardiac related deaths with eight terminal ischemic cardiopathies, two sudden deaths, and two cardiac failures.

Conclusions:

- Mitral valve repair provides excellent survival. However, longterm outcome can be negatively influenced by perioperative risk factors.
- Risk of reoperation is higher in younger patients with a residual mitral regurgitation and without ring annuloplasty.

***Eur J Cardiothorac Surg* 2007;32:301-307** Marie-A Rey Meyer, Ludwig K. von Segesser, Michel Hurni, Frank Stumpe, Karam Eisa, Patrick Ruchat *
Department of Cardiovascular Surgery, University Hospital, Lausanne, Switzerland

Long term follow-up of open commissurotomy versus bileaflet valve replacement for rheumatic mitral stenosis'

Table 1
Survival and complication free estimates

	Group A	Group B
Survival (%)	98.7 ± 1 (0.13)	93.7 ± 3 (0.68)
Reoperation (%)	88.2 ± 2 (1.2)	97.8 ± 1 (0.39)
Thrombosis (%)	—	95.4 ± 2 (0.59)
Thrombo-embolism (%)	93.7 ± 2 (0.62)	83 ± 7 (1.47)
Bleeding (%)	99.3 ± 0.5 (0.09)	98.4 ± 1 (0.29)

Linearised rates are expressed in brackets (Patient/year %).

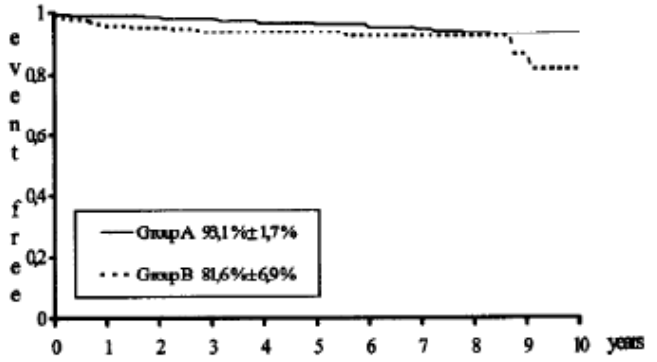


Fig. 2. Cumulated thrombo-embolic and haemorrhagic complication free curves calculated with the Kaplan–Meier method. The comparison carried out with the log-rank test approached statistical significance ($P = 0.055$).

Conclusions: Long term results of mitral commissurotomy were more satisfactory than those obtained with bileaflet valves.
Reoperation rate was higher in mitral commissurotomy.

Eur J Cardiothorac Surg 1997;12:335-339
M Cotrufo, A Renzulli, N Vitale, G Nappi, M De Feo, G Ismeno and B Di Benedetto

Biological versus prosthetic ring in mitral-valve repair: enhancement of mitral annulus dynamics and left-ventricular function with pericardial annuloplasty at long term

Methods: Forty-four consecutive patients were retrospectively enrolled. All patients had isolated posterior-leaflet prolapse and
underwent identical surgical mitral-valve reconstruction (quadrangular resection of the posterior lea¯et associated with annuloplasty).
Twenty-three patients underwent mitral annuloplasty with an autologous pericardial ring (group I), whereas 21 patients had MVR with a
Carpentier±Edwards rigid ring (group II).

Conclusions: The autologous pericardium seems to be superior to rigid prosthetic rings for annuloplasty in MVR since it provides more favourable mitral annulus dynamics and preserves LV function during stress
conditions. Effective and durable annular remodelling with the autologous pericardium is achieved up to 6 years from surgery, with no echocardiographic sign of degeneration in the long term

Eur J Cardiothorac Surg 2000;17:431-439 Cardiac Surgery Division, Civil Hospital, Piazzale Spedali Civili n8 1, 25125 Brescia, Italy

Mitral Valve Replacement Versus Repair: Propensity-Adjusted Survival and Quality-of-Life Analysis

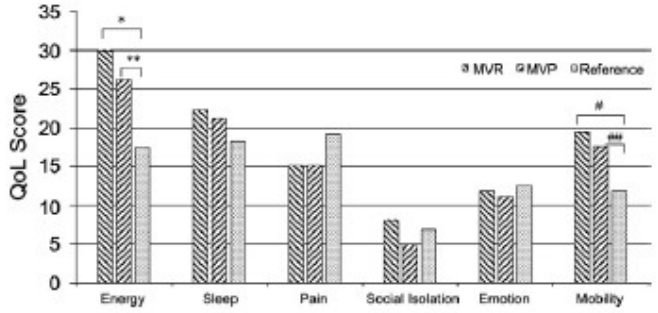


*Fig 2. Nottingham Health Profile quality-of-life (QoL) analysis. Statistical differences between the mitral valve repair (MVP) and mitral valve replacement (MVR) groups versus an age- and sex-matched reference population are shown as follows: *p = 0.002; **p = 0.004; #p = 0.01; ##p = 0.03.*

Table 4. Mortality and Morbidity During Early and Late Follow-Up

Variable	MVP (n = 85)	MVR (n = 99)	p Value
Myocardial infarction	22 (25.9%)	20 (20.2%)	0.36
Fatal	16 (18.8%)	17 (17.2%)	1.00
Nonfatal	6 (7.1%)	3 (3.0%)	0.21
Valve-related death	1 (1.2%)	4 (4.0%)	0.18
Noncardiac death			
Malignancy	2 (2.4%)	7 (7.1%)	
Pneumonia	...	2 (2.0%)	
Pancreatitis	...	2 (2.0%)	
Cerebral infarction	...	1 (1.0%)	
Intracerebral bleeding	...	1 (1.0%)	
Other causes	3 (3.5%)	6 (6.1%)	0.06
Cerebrovascular events			
Stroke or ICB	7 (8.2%)	3 (3.0%)	0.18
Cardiac interventions			
Coronary angiography	2 (2.4%)	4 (4.0%)	
PTCA	...	1 (1.0%)	
MVP to MVR	...	1 (1.0%)	
Pacemaker implantation	3 (3.5%)	2 (2.0%)	0.83

ICB = intracerebral bleeding; MVP = mitral valve repair; MVR = mitral valve replacement; PTCA = percutaneous transluminal coronary angioplasty.

Conclusions.

- **Survival is longer after MVP than after MVR.**
- **The quality of life of MVP and MVR patients does not differ from each other.**

Ann Thorac Surg 2007;84:451-458 Finland, Helsinki
Janne J. Jokinen, Mikko J. Hippeläinen, Otto A. Pitkänen and Juha E.K. Hartikainen

Mitral Valve Repair Versus Replacement in Simultaneous Mitral and Aortic Valve Surgery for Rheumatic Disease

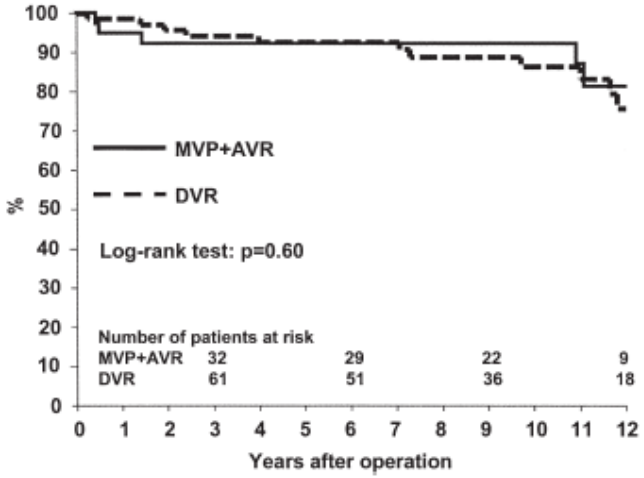


Fig 1. Freedom from cardiac-related death in mitral valve repair plus aortic valve replacement (MVP + AVR; solid line) and double valve replacement (DVR; dashed line) patients. No statistically significant difference was seen between the two groups.

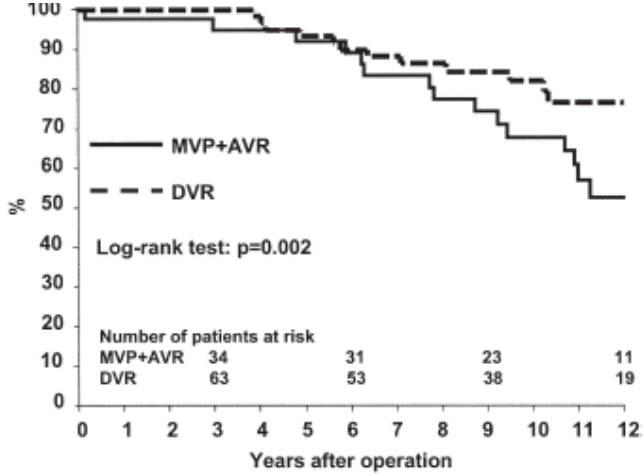


Fig 2. Freedom from mitral valve reoperation in mitral valve repair plus aortic valve replacement (MVP + AVR; solid line) and double valve replacement (DVR; dashed line) patients. A statistically significant difference (52% versus 76% at 12 years; p = 0.002) was seen between the two groups.

Conclusions.

- **Potential advantages of preserving, rather than replacing, the native mitral valve, such as better cardiac survival or fewer thromboembolic complications, were not identified in combined mitral valve repair and aortic valve replacement compared with double valve replacement for patients with rheumatic disease.**
- **Indeed, combined mitral valve repair and aortic valve replacement was associated with a significantly higher incidence of mitral valve reoperation.**
- **In double valve surgery for rheumatic disease, mitral valve repair should be limited to the correction of mitral valve lesions only when excellent durability can be expected.**

Ann Thorac Surg 2007;83:558-563 Japan Kenji Kuwaki

Mitral Valve Repair and Replacement in Endocarditis: A Systematic Review of Literature

Table 2. Outcome After Mitral Valve Repair Versus Mitral Valve Replacement

	Mitral Valve Repair (n = 470 patients)	Mitral Valve Replacement (n = 724 patients)	*p* Value
Mortality			
Early (< 30 days)	11/470 (2.3%) [13]	104/724 (14.4%) [17]	< 0.0001
Late (≥ 30 days)	24/307 (7.8%) [10]	137/338 (40.5%) [8]	< 0.0001
Morbidity			
Early			
Reoperation	7/319 (2.2%) [9]	26/205 (12.7%) [5]	< 0.0001
Recurrent endocarditis	1/217 (0.5%) [8]	3/253 (1.2%) [8]	0.63
Thromboembolism	2/130 (1.5%) [4]	0/17 (0.0%) [2]	0.20
Cerebrovascular event	7/150 (4.7%) [5]	19/165 (11.5%) [4]	0.045
Late			
Reoperation	20/430 (4.7%) [12]	26/298 (8.7%) [9]	0.039
Recurrent endocarditis	6/328 (1.8%) [11]	28/386 (7.3%) [9]	0.0013
Thrombo-embolism	6/185 (3.2%) [6]	0/7 (0.0%) [1]	0.15
Cerebrovascular event	3/188 (1.6%) [5]	11/45 (24.4%) [2]	< 0.0001

Number of events/number of total patients (%) [number of studies with available data].

Conclusions.

A systematic review of literature showed that mitral valve repair is associated with good clinical in-hospital and long-term results among patients undergoing surgery for infective endocarditis.

Ann Thorac Surg 2007;83:564-570 Harm H.H. Feringa, Netherlands

Comparison of survival after mitral valve replacement with biologic and mechanical valves in 1139 patients

Methods:
Retrospective survival analysis was performed on data from 1139 consecutive patients older than 18 years of age undergoing mitral valve replacement with Carpentier Edwards (n = 495; Baxter Healthcare Corp, Irvine, Calif) or St JudeMedical (n = 644; St Jude Medical, Inc, St Paul, Minn) prostheses.

Results:
- The 10-year survival was not statistically different between the patients receiving Carpentier-Edwards valves and those receiving St Jude Medical valves (*P* = .16).
- Predictors of worse survival after mitral valve replacement are older age, lower ejection fraction, presence of class IV congestive heart failure, coronary artery disease, renal disease, smoking history, hypertension, concurrent other valve surgery, and redo heart surgery.

J Thorac Cardiovasc Surg 2001;122:569-577 Ye-Ying Cen, Donald D. Glower Duke University Medical Center, Durham, NC

Valve repair versus valve replacement for degenerative mitral valve disease

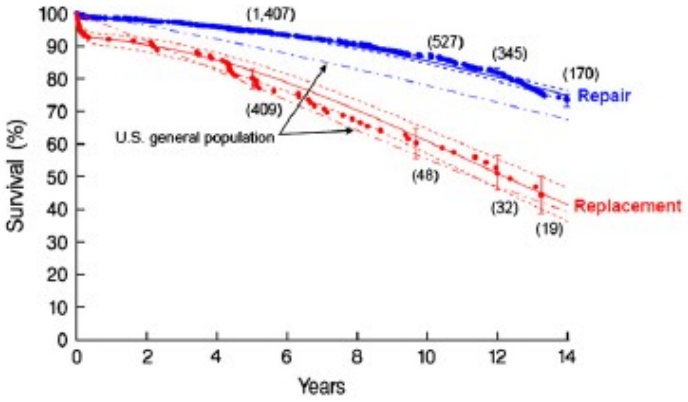


Figure 2. Unadjusted survival after mitral valve repair (*blue*) or replacement (*red*) compared with age and sex-matched US population (*dot-dash curves*). Each symbol represents a death, and vertical bars are 68% actuarial confidence limits. Numbers in parentheses represent patients remaining at risk. Solid lines are parametric survival estimates enclosed within dashed 68% confidence limits.

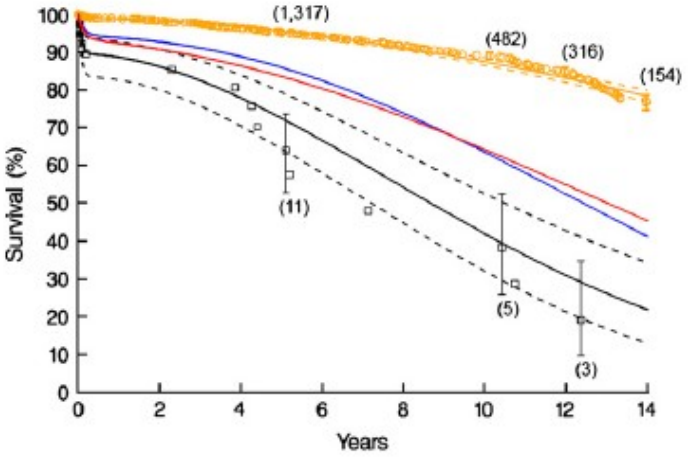


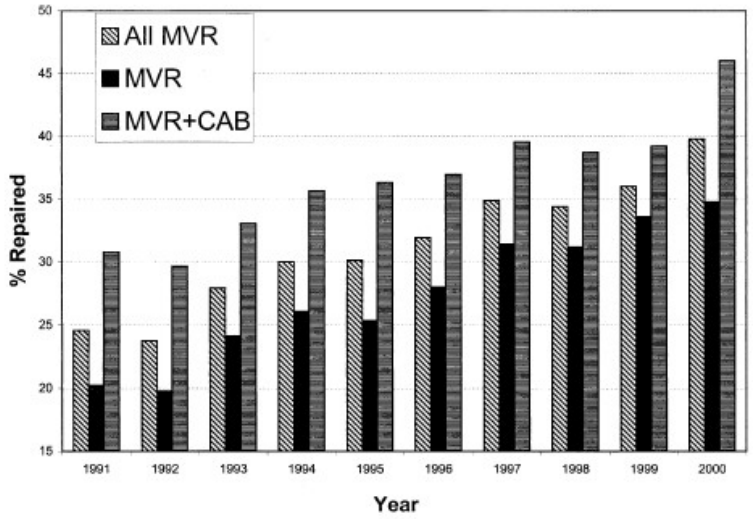
Figure 4. Survival in propensity-matched patients having repair (*blue*) or replacement (*red*) compared with unmatched patients having repair (*orange*) or replacement (*black*). Format is as in Figure 2.

A. Marc Gillinov, *J Thorac Cardiovasc Surg* 2008;135:885-893 Cleveland Clinic, Cleveland, Ohio.

Conclusions

- Mitral valve repair is the procedure of choice for patients with isolated degenerative valve disease, most of whom will be relatively young, at most mildly symptomatic, and in sinus rhythm with well-preserved left ventricular function and only posterior leaflet prolapse.
- Mitral valve repair preserves the native valve, has excellent durability, and spares the patient from known adverse events of prosthetic heart valves.
- It is reasonable to also consider valve repair in elderly patients and in those with complex prolapse and valvar calcification, particularly those in sinus rhythm, because this can eliminate the need for anticoagulation and risk of prosthesis related complications.
- If such a patient is also in atrial fibrillation, we now recommend mitral valve repair plus surgical ablation of atrial fibrillation.
- However, when valvar pathology is so severe that repair is infeasible, valve replacement does not diminish long-term survival.

Trends in Mitral Valve Surgery in the United States: Results From The Society of Thoracic Surgeons Adult Cardiac Database



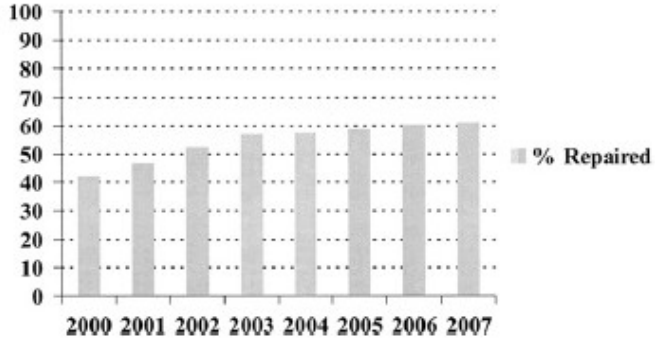


Fig 3. Overall mitral valve repair rates, percent repaired (gray bars), for isolated primary mitral valve operations, for the years 2000 to 2007 ($p < 0.0001$).

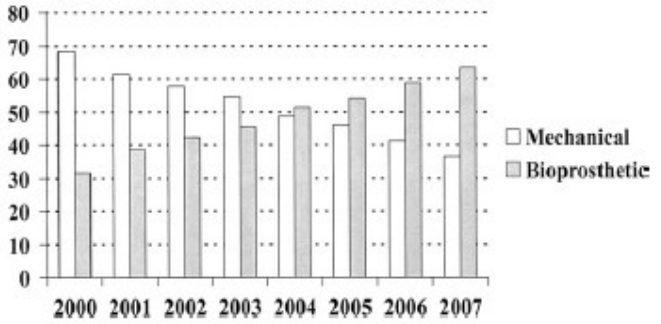


Fig 5. Mitral valve replacement type, mechanical (white bars) or bioprosthetic (gray bars), for the years 2000 to 2007 ($p < 0.0001$).

Ann Thorac Surg 2009;87:1431-1439 James S. Gammie, Shubin Sheng, Bartley P. Griffith, Eric D. Peterson, J. Scott Rankin Sean M. O'Brien and James M. Brown

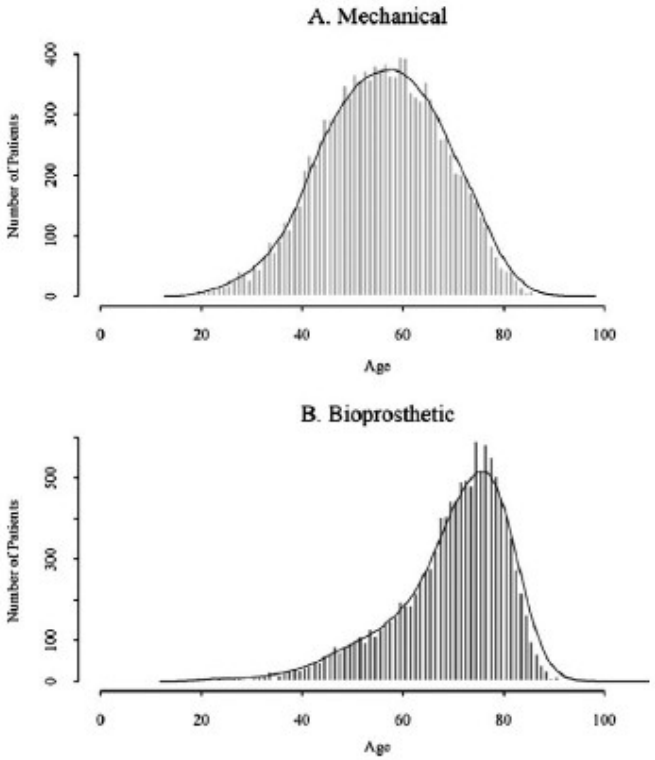


Fig 6. Age distribution of (A) mechanical and (B) bioprosthetic mitral valve recipients.

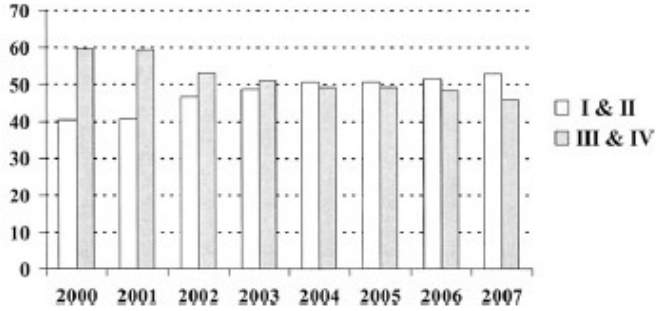


Fig 7. Functional class of patients undergoing mitral valve surgery, class I and II (white bars) and class III and IV (gray bars), for the years 2000 to 2007 ($p < 0.0001$).

Table 1. Characteristics of Mitral Valve (MV) Replacement and Repair Patients

Variable	Overall (n = 58,370)	MV Replacement (n = 25,671)	MV Repair (n = 32,699)	*p* Value
Age, years, median	62.0	64.0	60.0	<0.0001
Female, %	53.2	64.5	44.3	<0.0001
Diabetes mellitus, %	11.2	14.4	8.7	<0.0001
Renal failure, %	4.3	5.5	3.4	<0.0001
Chronic lung disease, %	17.4	22.4	13.6	<0.0001
Hypertension	54.2	57.1	51.8	<0.0001
Cerebrovascular accident	5.1	7.3	3.3	<0.0001
NYHA I (asymptomatic)	16.6	12.1	20.2	<0.0001
Ejection fraction, median (IQR)	55.0 (50–60)	55.0 (50–60)	55.0 (50–61)	0.0021
Mitral stenosis	18.1	33.8	5.8	<0.0001
Tricuspid regurgitation, moderate or severe, %	14.9	17.0	13.3	<0.0001
Procedure status, urgent	17.4	22.0	13.8	<0.0001

IQR = interquartile range; NYHA = New York Heart Association.

Table 2. Operative Characteristics and Outcomes of Mitral Valve (MV) Surgery

Variable	Overall (n = 58,370)	MV Replacement (n = 25,671)	MV Repair (n = 32699)	*p* Value
Perfusion time, min, median (IQR)	112 (87–144)	116 (91–149)	109 (84–140)	<0.0001
Cross-clamp time, min, median (IQR)	82 (63–107)	84 (65–111)	80 (60–105)	<0.0001
Reoperation, %	8.4	10.8	6.5	<0.0001
DSWI, %	0.24	0.30	0.19	0.0110
Permanent stroke, %	1.31	1.56	1.11	<0.0001
Dialysis, %	1.09	1.41	0.84	<0.0001
Postoperative LOS, days, median	6.0	7.0	6.0	<0.0001
Operative mortality, %	2.45	3.77	1.41	<0.0001

DSWI = deep sternal wound infection; IQR = interquartile range; LOS = length of stay.

A prospective study of changes in the quality of life of patients following mitral valve repair and replacementq

Conclusions:
Our study suggests that following mitral valve surgery there was significant improvement in the QOL of patients especially in those patients requiring mitral valve repair.
However, patients with impaired LV function and those with MR with end-systolic dimensions > 45 mm were unlikely to demonstrate a significant improvement in QOL at 3 months follow-up.

Eur J Cardiothorac Surg 2001;20:949-955, Department of Cardiothoracic Surgery, Walsgrave Hospital, Clifford Bridge Road, Coventry Ira R.A. Goldsmitha,b,*, Gregory Y.H. Lipb, Ramesh L. Patel

Ischemic mitral valve reconstruction and replacement: Comparison of long-term survival and complication

Methods: From January 1976 to January 1996, 223 patients with ischemic mitral insufficiency underwent mitral valve reconstruction (n = 152) or prosthetic mitral valve replacement (n = 71). Coronary artery bypass grafting was performed in 89% of cases of mitral reconstruction and 80% of cases of prosthetic replacement.

Conclusions:

- Initial mortalities were similar among patients undergoing prosthetic replacement and valve reconstruction.
- Poor outcome was primarily related to preexisting comorbidities.
- Patients undergoing valve reconstruction had fewer valve related complications.
- Valve reconstruction resulted in excellent durability and freedom from complications. These findings suggest that mitral valve reconstruction should be considered for appropriate patients with ischemic mitral insufficiency.

J Thorac Cardiovasc Surg 2001;122:1107-1124Eugene A. Grossi, New York University School of Medicine, New York, NY.

Is repair preferable to replacement for ischemic mitral regurgitation?

Clinical Inferences and Decision-Making

- Patients who require mitral valve surgery for ischemic mitral regurgitation can be classified by echocardiography and direct inspection as having a ruptured papillary muscle, infarcted but unruptured papillary muscle, or functional ischemic mitral regurgitation.
- Late survival is poor for all groups, with most patients dying within 7 years of surgery.
- However, choice of surgical procedure has an important impact on late survival. Most patients derive a survival advantage from mitral valve repair rather than replacement. Among the most severely ill patients, the survival benefit of mitral valve repair is diminished.
- When mitral valve repair is performed, a formal annuloplasty should be used, and left anterior descending disease should be treated by ITA grafting.

A. Marc Gillinov, *J Thorac Cardiovasc Surg* 2001;122:1125-1141 Cleveland Clinic Foundation, Cleveland,Ohio.

Recurrent mitral regurgitation after repair: Should the mitral valve be re-repaired?

Methods:
One hundred forty-five patients with recurrent mitral regurgitation after primary mitral valve repair of degenerative leaflet prolapse underwent mitral valve reoperations between January 1, 1970, and January 1, 2005. The mean age was 66 years, and 102 (70%) were men.

Conclusion:
Recurrent mitral regurgitation after prior repair is frequently caused by new valve pathology.
Mitral re-repair is performed in almost half of patients and is associated with superior survival, improved ejection fraction, and greater regression in ventricular dimension compared with valve replacement.

1. **Rakesh M. Suri, *J Thorac Cardiovasc Surg* 2006;132:1390-1397 Mayo Clinic**
2. **(Ann Thorac Surg 2008;86:1480–4) Reoperation for Failure of Mitral Valve Repair in Degenerative Disease: A Single-Center Experience Paris, France**