EuroValve
March 10-11, 2016

The current gold standard in primary MV repair:importance of patient selection

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Associate Professor of Cardiac Surgery
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Faculty disclosure

Alessandro Parolari MD PhD

I have ***no financial relationships*** *to disclose.*

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FACOLTÀ DI MEDICINA E CHIRURGIA

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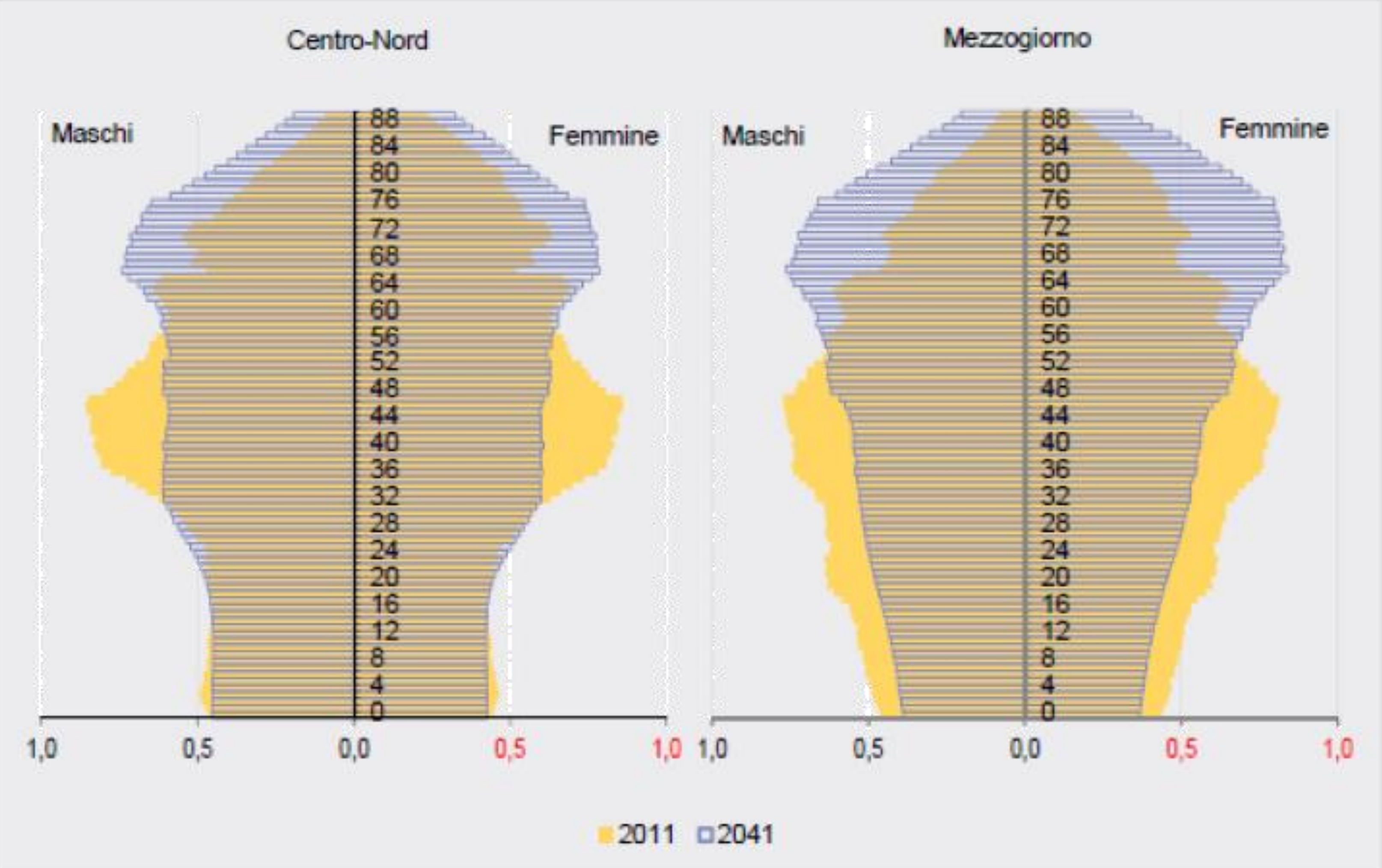
Figura 4.1 **Piramidi delle età a confronto. Centro-Nord e Mezzogiorno - Anni 2011 e 2041** (a) (valori percentuali)



Fonte: Istat, Censimento popolazione e abitazioni; Previsioni demografiche
(a) Previsioni demografiche (Anni 2011-2065) - dati pre-Censimento 2011 di fonte anagrafica. Scenario centrale.

http://www.istat.it/it/files/2014/05/cap4.pdf

THE NEXT FOUR DECADES
The Older Population in the United States: 2010 to 2050

Issued May 2010

Population Estimates and Projections

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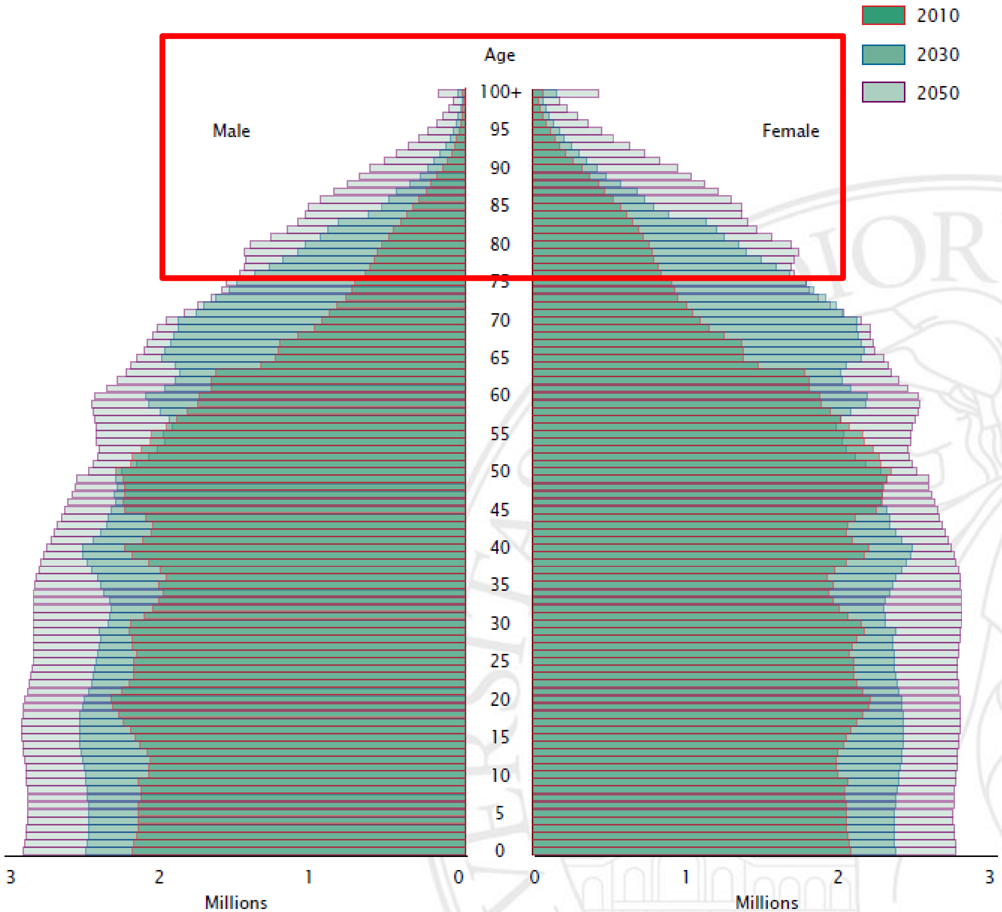
Figure 1.
Age and Sex Structure of the Population for the United States: 2010, 2030, and 2050



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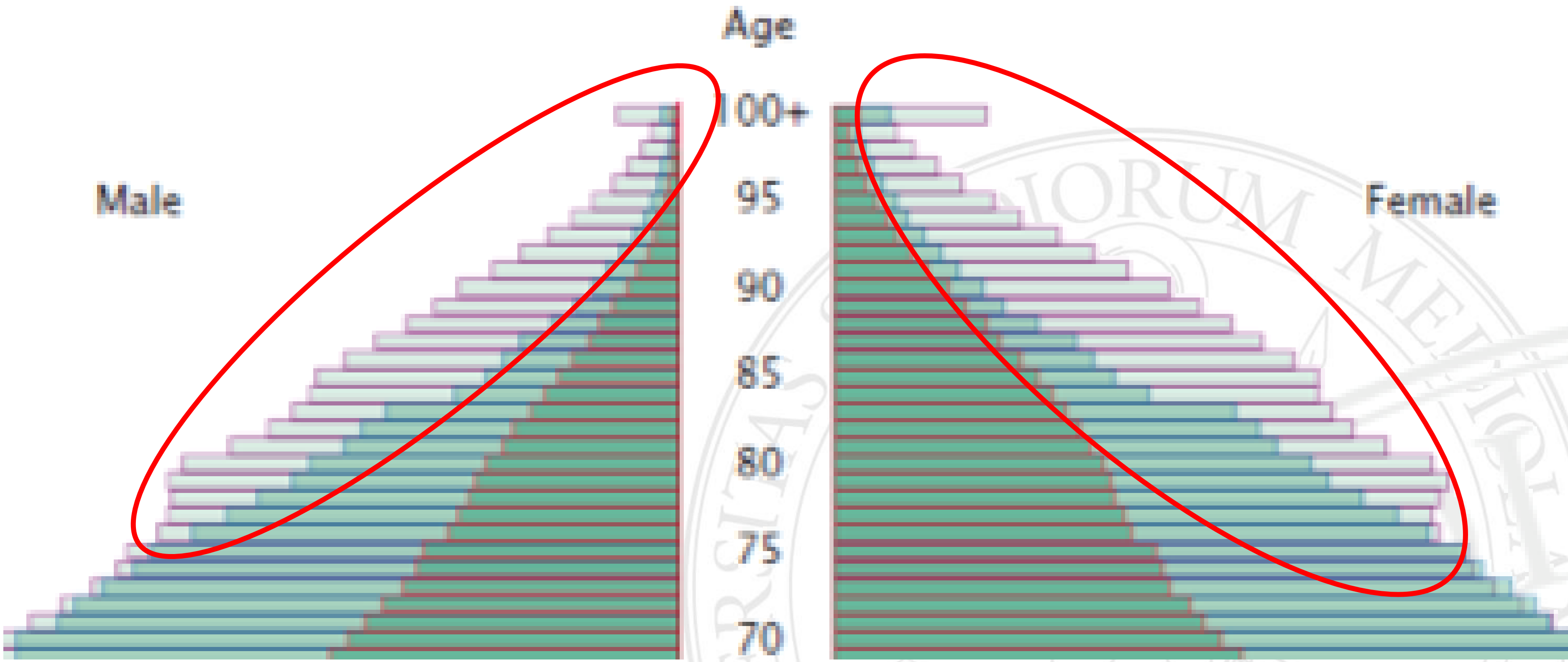
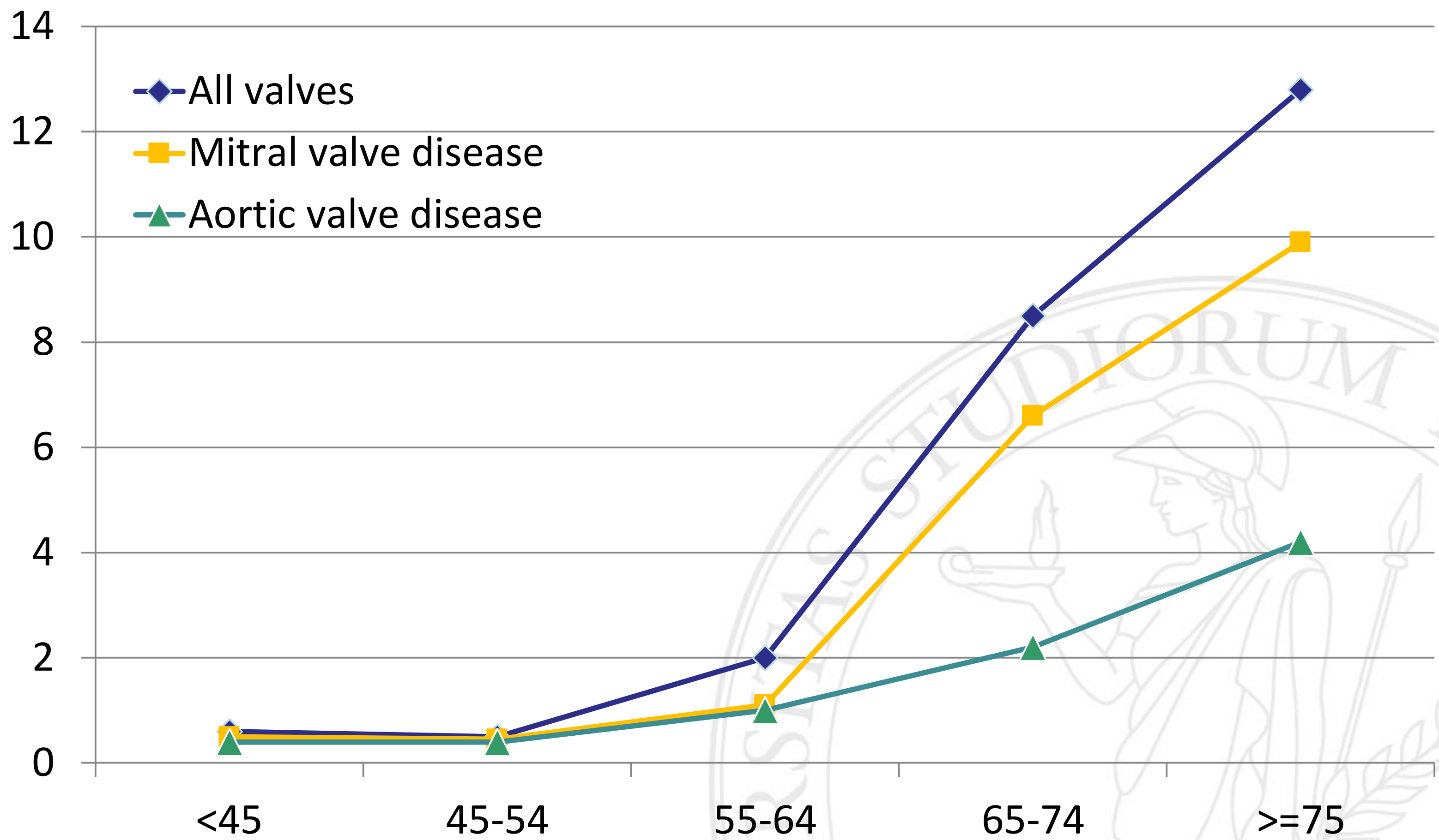


Burden of valvular heart diseases: a population-based study

Vuyisile T Nkomo, Julius M Gardin, Thomas N Skelton, John S Gottdiener, Christopher G Scott, Maurice Enriquez-Sarano



Advantages of mitral valve repair
vs
mitral valve replacement

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- *preservation* of *left ventricular function*
- Improved freedom from endocarditis, thromboembolism, and from anticoagulant-related hemorrhage
- *improved survival*.

For these reasons, *valve repair is preferred* to valve replacement in patients with *degenerative mitral valve disease*.

VS

Gillinov AM. Durability of mitral valve repair for degenerative disease. J Thorac Cardiovasc Surg. 1998;116:734-43. 2. Suri RM. Survival advantage and improved durability of mitral repair for leaflet prolapse subsets in the current era. Ann Thorac Surg. 2006;82: 819-26.

Valve repair versus valve replacement for degenerative mitral valve disease

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A. Marc Gillinov, MD,[a] Eugene H. Blackstone, MD,[a,b] Edward R. Nowicki, MD,[a] Worawong Slisatkorn, MD,[a]

Factors associated with type of mitral valve surgery

Factors	Estimate ± SE	P	Reliability (%)*
Associated with replacement			
Older age	1.26 ± 0.111	<.0001	100
Anterior or bileaflet prolapse	2.1 ± 0.178	<.0001	82
MV calcification	1.09 ± 0.173	<.0001	90
Surgeon A	2.2 ± 0.56	<.0001	58
Surgeon B	2.1 ± 0.38	<.0001	83
Surgeon C	1.54 ± 0.55	.005	54
Associated with repair			
More recent date of operation	−0.033 ± 0.0162	.04	65
Surgeon D	−1.44 ± 0.179	<.0001	99

MV, Mitral valve; *SE*, standard error. *Percent of occurrences in 500 bootstrap models.

Valve repair versus valve replacement for degenerative mitral valve disease

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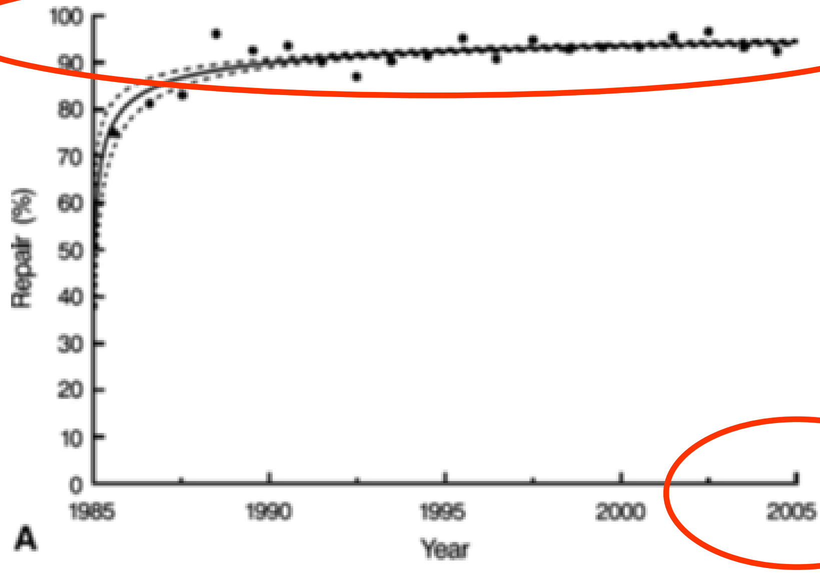
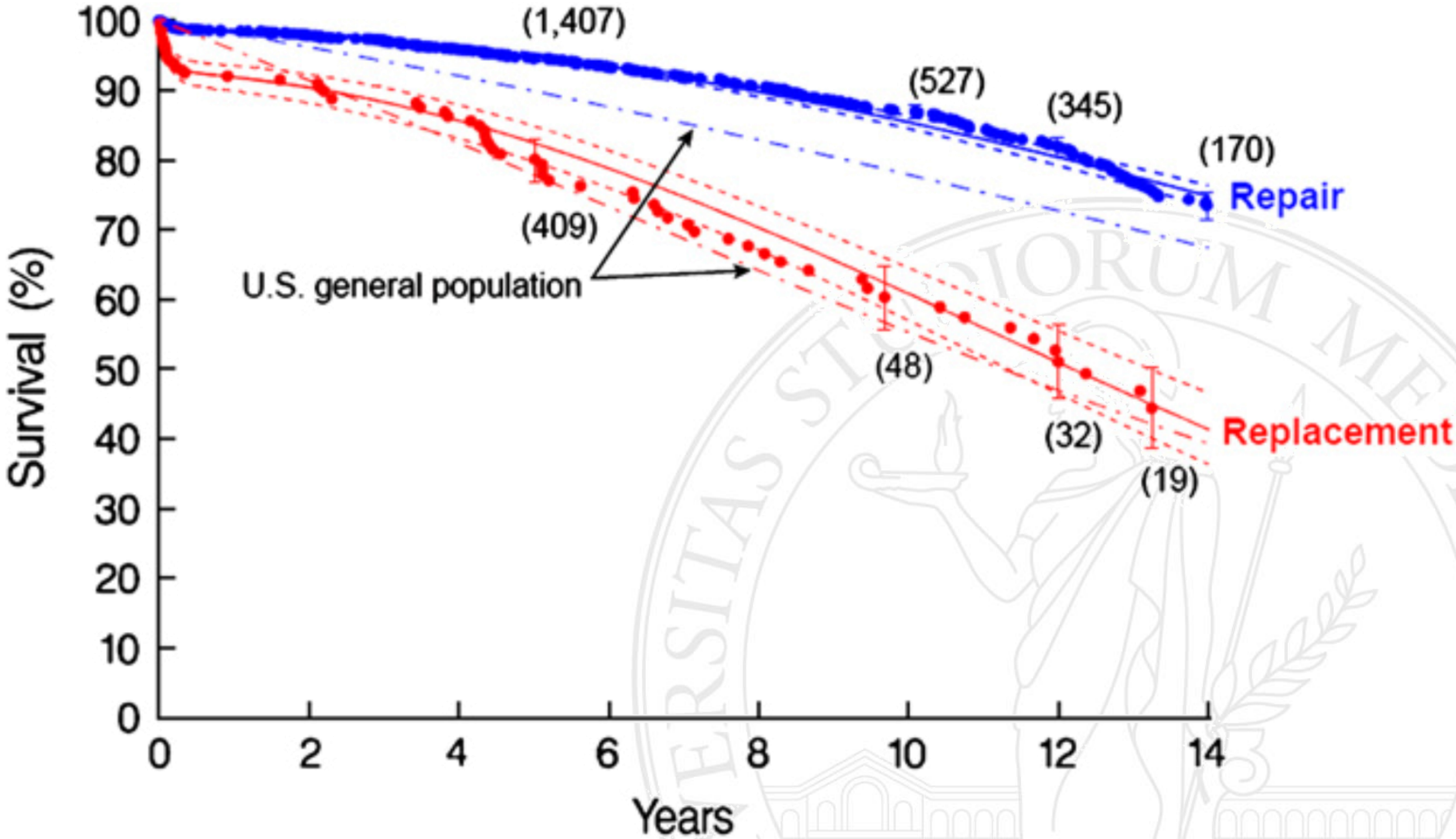


VS

J Thorac Cardiovasc Surg 2008;135:885-93

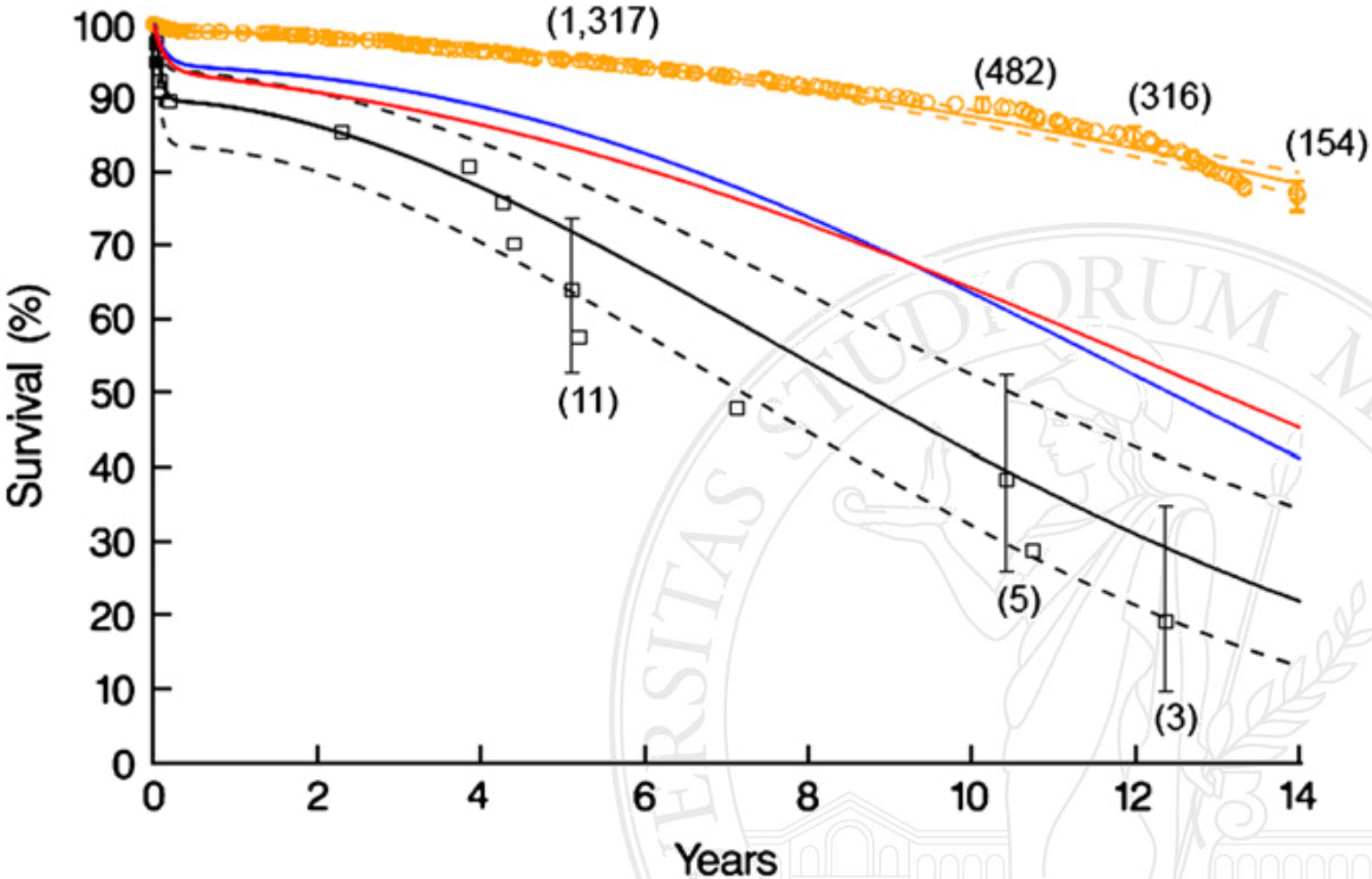
Unadjusted survival after mitral valve repair (blue) or replacement (red) compared with age and sex-matched **US population** (dot-dash curves).



Valve repair versus valve replacement for degenerative mitral valve disease

A. Marc Gillinov, MD,[a] Eugene H. Blackstone, MD,[a,b] Edward R. Nowicki, MD,[a] Worawong Slisatkorn, MD,[a]

Survival in propensity-matched patients having repair (blue) or replacement (red) compared with **unmatched** patients having repair (orange) or **replacement (black)**.



Valve repair versus valve replacement for degenerative mitral valve disease

A. Marc Gillinov, MD,[a] Eugene H. Blackstone, MD,[a,b] Edward R. Nowicki, MD,[a] Worawong Slisatkorn, MD,[a]

Survival in propensity-matched patients having repair (blue) or replacement (red) compared with age-sex–matched US population (green).

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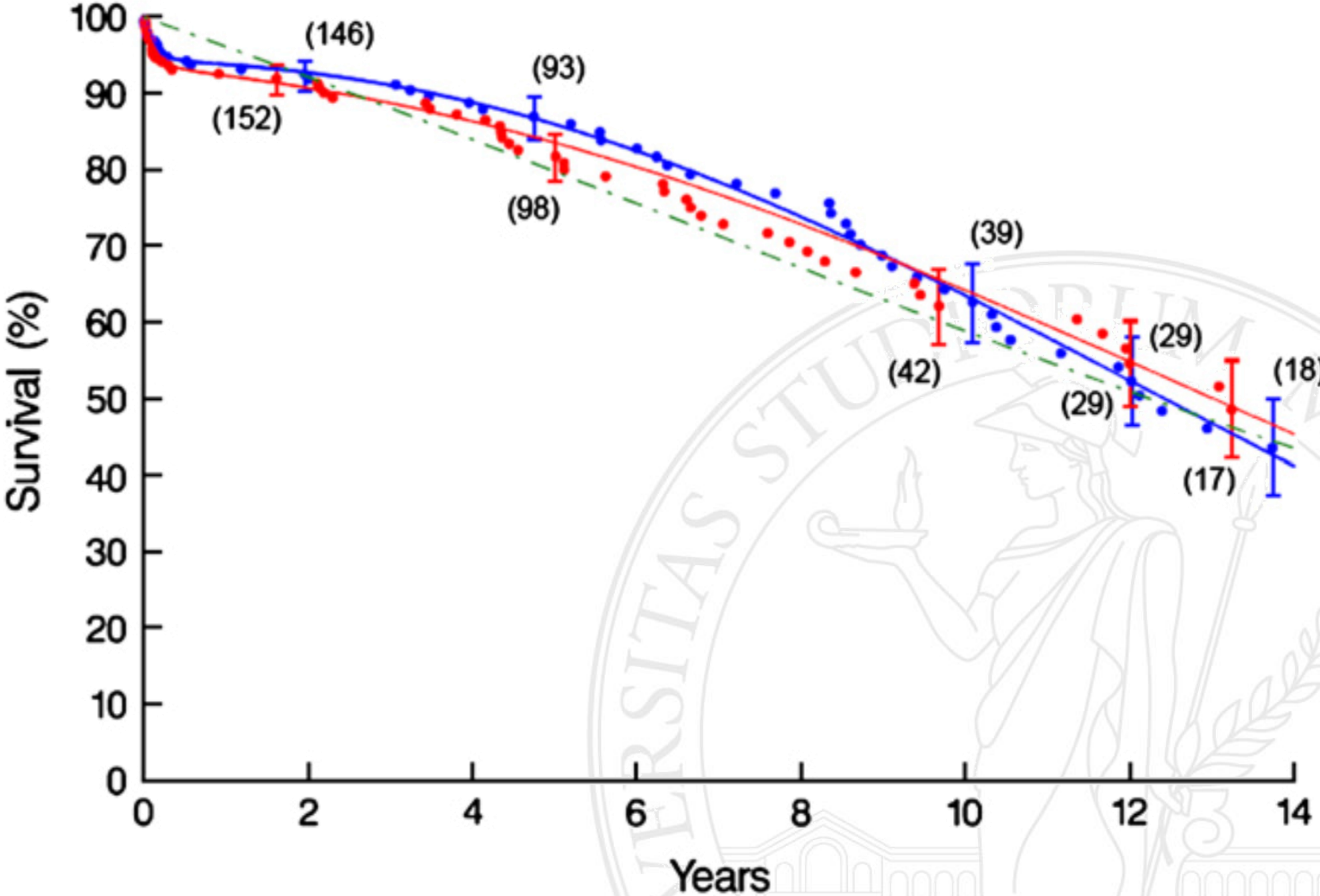

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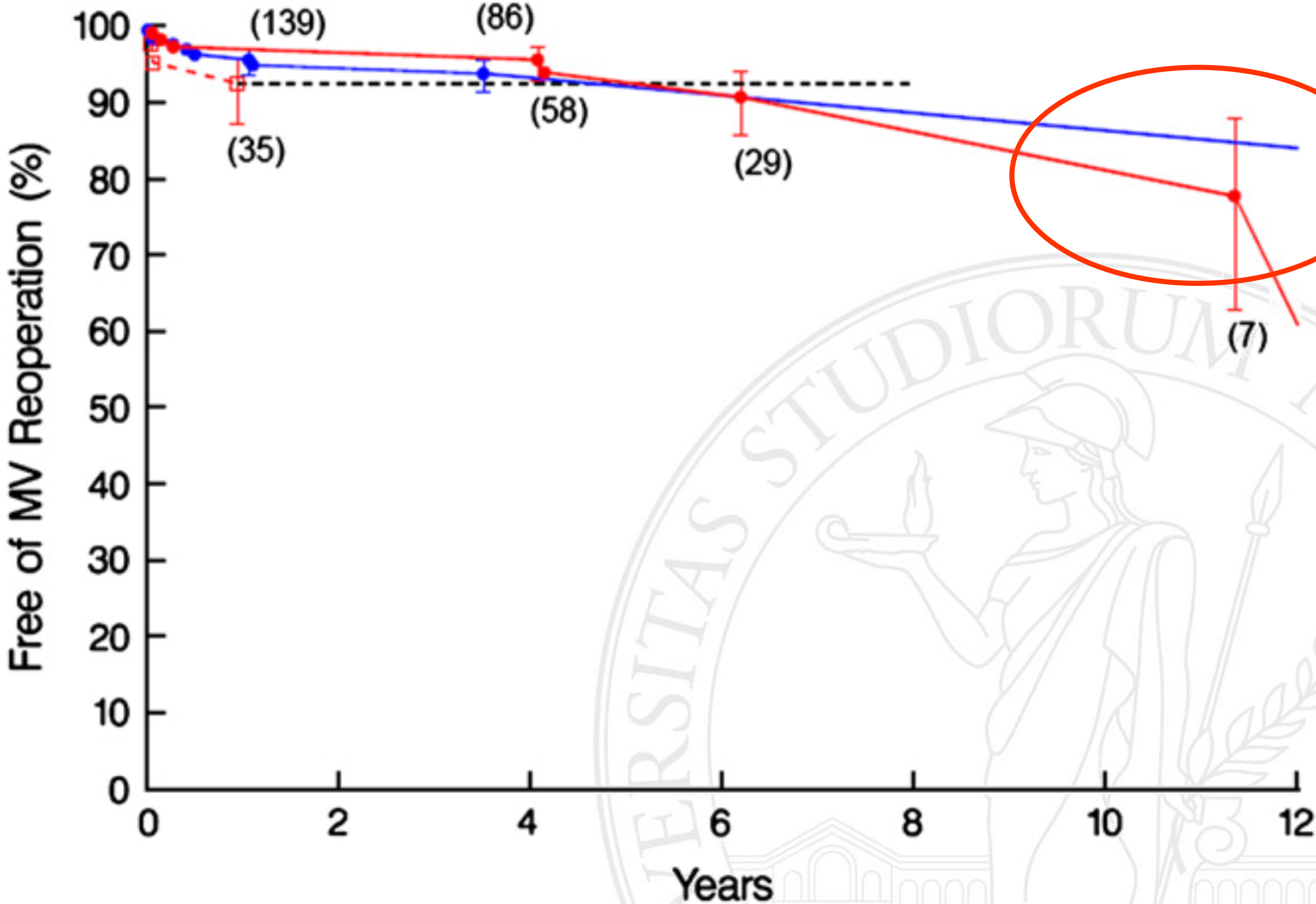
Valve repair versus valve replacement for degenerative mitral valve disease

A. Marc Gillinov, MD,[a] Eugene H. Blackstone, MD,[a,b] Edward R. Nowicki, MD,[a] Worawong Slisatkorn, MD,[a]

Reoperation in propensity-matched patients after mitral valve repair (blue), replacement with bioprosthetic valve (red), or replacement with **mechanical valve (black).**



Valve repair versus valve replacement for degenerative mitral valve disease

A. Marc Gillinov, MD,[a] Eugene H. Blackstone, MD,[a,b] Edward R. Nowicki, MD,[a] Worawong Slisatkorn, MD,[a]

- *Over the years MV repair has progressively taken over with respect to MV replacement*

- Survival, however, seems to be similar once you adjust for clinical features (balancing scores)

- *Late reoperation is still an issue both in MV repair and in MV replacement with bioprostheses*

VS

Two different issues:

1. What is the gold standard in primary MV repair
2. What is the role of patient selection

The progressively evolving field of MV repair

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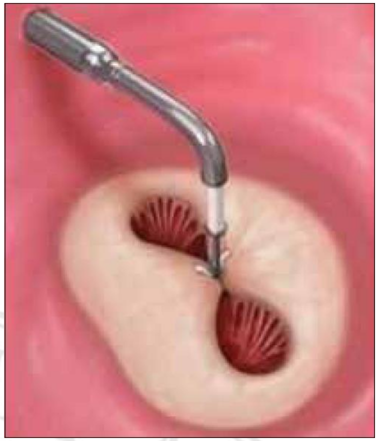
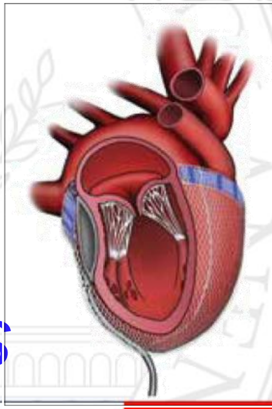
- *Minimally invasive surgery*
  - *ministernotomy*
  - *minithoracothomy*



- *Robotic surgery*

- *Transcatheter transfemoral approaches*
  - *Mitraclip & co.*
  - *Transcatheter valves*



- *Transcathether transapical approaches*

The progressively evolving field of MV repair

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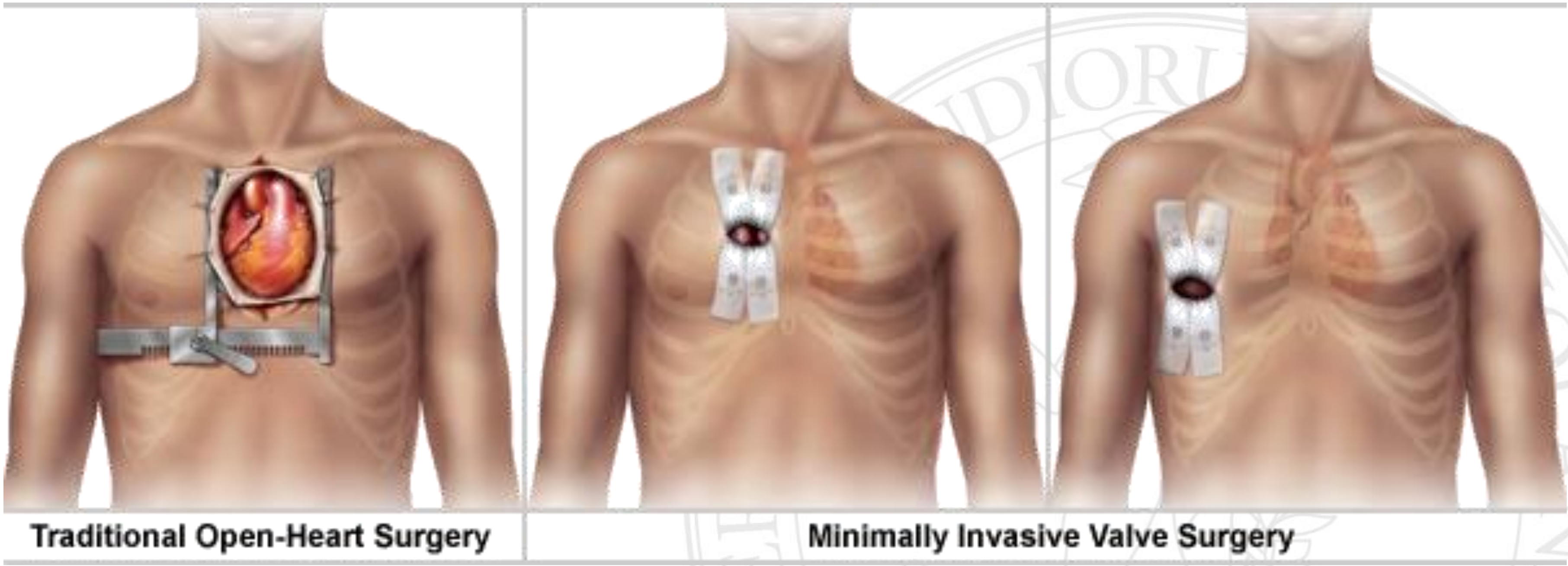
Minimally invasive surgery has revolutionized many facets of surgical practice over the past few decades, including a range of *procedures in cardiac surgery*.



Ann Cardiothorac Surg. 2013 Nov; 2(6): 693–703.
10.3978/j.issn.2225-319X.2013.11.08

The importance of patient selection: how to choose among all these options?

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- *Minimally invasive surgery*
  - *ministernotomy*
  - *minithoracothomy*

- *Robotic surgery*

- *Transcatheter transfemoral approaches*
  - *Mitraclip & co.*
  - *Transcatheter valves*

- *Transcatheter transapical approaches*

Minimally invasive mitral valve surgery: a systematic review and meta-analysis

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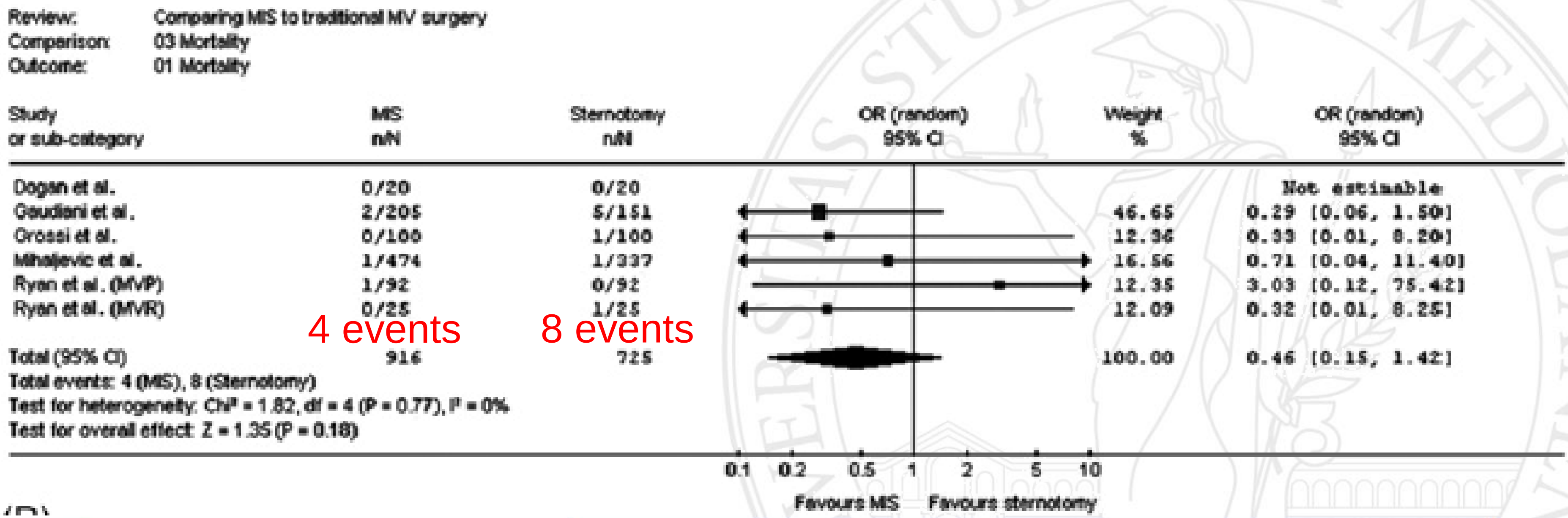
Paul Modi, Ansar Hassan, Walter Randolph Chitwood Jr.*

Table 2
Meta-analysis of outcomes

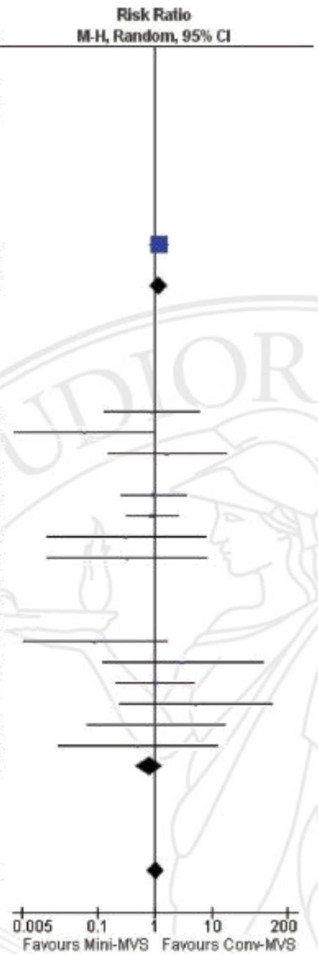
Outcome	No. of patients	No. of studies	OR/WMD (95% CI)	p value	Heterogeneity, χ^2	χ^2, p value
Mortality	1641	6	0.46 (0.15 to 1.42)	0.18	1.82	0.77
Stroke	1801	6	0.66 (0.23 to 1.93)	0.45	6.77	0.24
CPB	871	8	25.81 (13.13 to 38.50)	<0.0001	27.05	0.0003
XC	671	7	20.91 (8.79 to 33.04)	0.0007	24.98	0.0003
Re-op for bleeding	1553	5	0.56 (0.35 to 0.90)	0.02	0.63	0.96
New onset AF	539	4	0.86 (0.59 to 1.27)	0.45	2.25	0.52
ICU stay	309	4	−0.36 (−0.80 to 0.08)	0.1	3.26	0.35
Hospital stay	350	5	−0.73 (−1.52 to 0.05)	0.07	1.75	0.78



Minimally Invasive Versus Conventional Open Mitral Valve Surgery

A Meta-Analysis and Systematic Review

Study or Subgroup	Mini-MVS Events	Mini-MVS Total	Conv-MVS Events	Conv-MVS Total	Weight	Risk Ratio M-H, Random, 95% CI
4.2.1 RCTs						
Dogan 2005	0	20	0	20		Not estimable
El-Fiky 2000	0	50	0	50		Not estimable
Subtotal (95% CI)		**70**		**70**		**Not estimable**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
4.2.2 Propensity comparison						
Gammie 2010	55	4322	47	4322	67.3%	1.17 [0.79, 1.72]
MT-2010	0	261	0	114		Not estimable
Subtotal (95% CI)		**4583**		**4436**	**67.3%**	**1.17 [0.79, 1.72]**
Total events	55		47			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.80 (P = 0.43)						
4.2.3 Cohort						
Bolotin 2004	2	38	2	33	2.8%	0.87 [0.13, 5.83]
Burfeind 2002	0	60	21	155	1.3%	0.06 [0.00, 0.97]
Chitwood 1997	1	31	2	100	1.8%	1.61 [0.15, 17.19]
Folliguet 2006	0	25	0	25		Not estimable
Galloway 2009	9	712	3	223	6.0%	0.94 [0.26, 3.44]
Gersak 2005	6	105	7	110	9.0%	0.90 [0.31, 2.58]
Glower 1998	0	21	1	20	1.0%	0.32 [0.01, 7.38]
Grossi 2001a	0	100	1	100	1.0%	0.33 [0.01, 8.09]
Karagoz 1999a	0	54	0	29		Not estimable
Raanani 2010	0	61	0	82		Not estimable
Ruttmann 2006	0	41	0	64		Not estimable
Ryan 2010 Rpl	0	43	5	43	1.2%	0.09 [0.01, 1.59]
Ryan 2010 Rpr	1	177	0	177	1.0%	3.00 [0.12, 73.15]
Srivastava 1998	3	52	3	52	4.2%	1.00 [0.21, 4.73]
Suri 2009	2	350	0	365	1.1%	5.21 [0.25, 108.21]
Wang 2009	1	192	1	203	1.3%	1.06 [0.07, 16.79]
Woo 2006	0	25	1	39	1.0%	0.51 [0.02, 12.12]
Subtotal (95% CI)		**2087**		**1820**	**32.7%**	**0.80 [0.46, 1.39]**
Total events	25		47			
Heterogeneity: Tau² = 0.00; Chi² = 9.95, df = 12 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.80 (P = 0.42)						
Total (95% CI)		**6740**		**6326**	**100.0%**	**1.03 [0.75, 1.42]**
Total events	80		94			
Heterogeneity: Tau² = 0.00; Chi² = 10.86, df = 13 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.19 (P = 0.85)						
Test for subgroup differences: Not applicable						



All-cause mortality up to 30 days. MVS, mitral valve surgery; RCT, randomized controlled trial.

Innovations • Volume 6, Number 2, March/April 2011

Minimally Invasive Versus Conventional Open Mitral Valve Surgery

A Meta-Analysis and Systematic Review

Davy C. H. Cheng, MD, Janet Martin, PharmD, MSc (HTA&M),*† Avtar Lal, MD, PhD,**
Anno Diegeler, MD, PhD,‡ Thierry A. Folliguet, MD,§ L. Wiley Nifong, MD,|| Patrick Perier, MD,‡
*Ehud Raanani, MD,¶ J. Michael Smith, MD,# Joerg Seeburger, MD,** and Volkmar Falk, MD††*

	Mini-MVS		Conv-MVS			Risk Ratio
Study or Subgroup	**Events**	**Total**	**Events**	**Total**	**Weight**	**M-H, Random, 95% CI**
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Study or Subgroup	Mini-MVS Events	Mini-MVS Total	Conv-MVS Events	Conv-MVS Total	Weight	Risk Ratio M-H, Random, 95% CI
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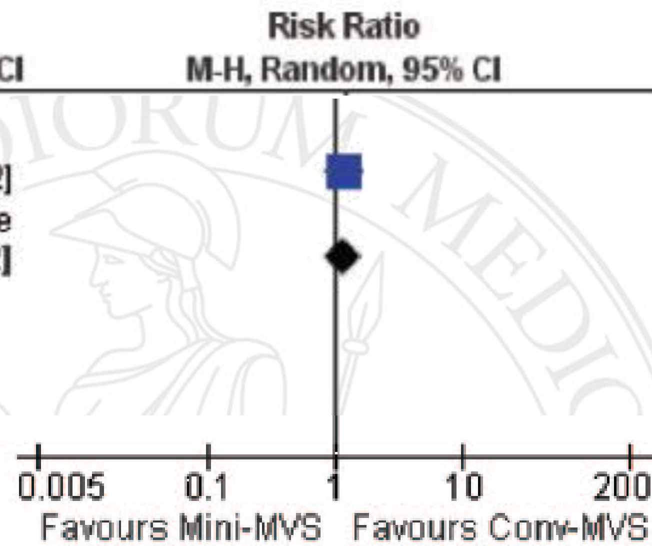

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Glower 1998	0	21	1	20	1.0%	0.32 [0.01, 7.38]
Grossi 2001a	0	100	1	100	1.0%	0.33 [0.01, 8.09]
Karagoz 1999a	0	54	0	29		Not estimable
Raanani 2010	0	61	0	82		Not estimable
Ruttmann 2006	0	41	0	64		Not estimable
Ryan 2010 Rpl	0	43	5	43	1.2%	0.09 [0.01, 1.59]
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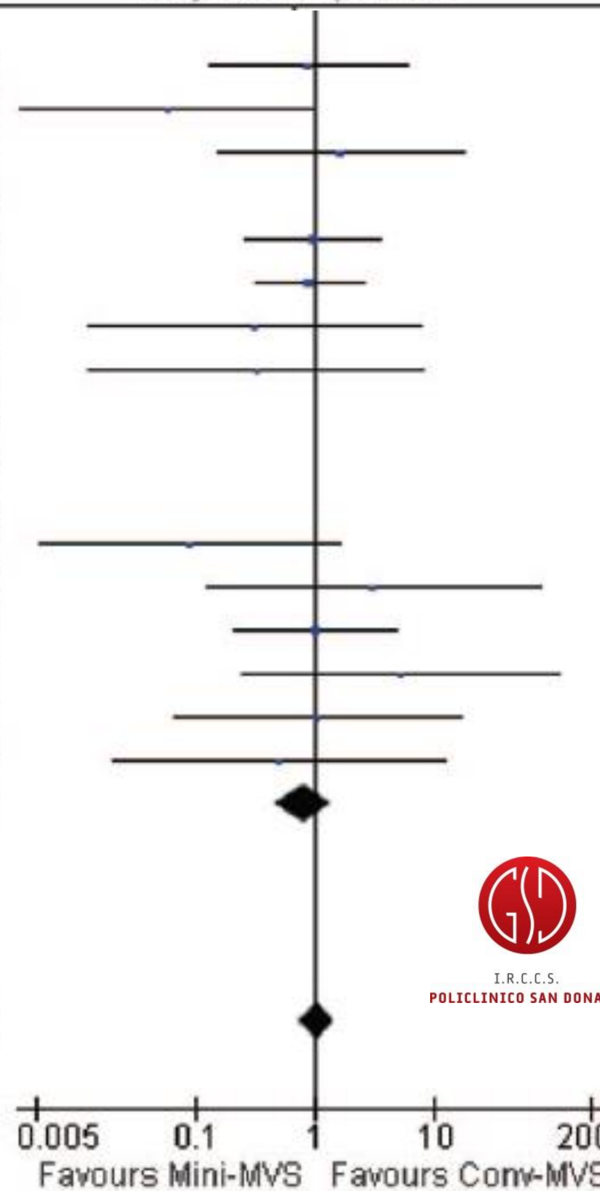
Subtotal (95% CI)		**2087**		**1820**	**32.7%**	**0.80 [0.46, 1.39]**
Total events	25		47			
Heterogeneity: Tau² = 0.00; Chi² = 9.95, df = 12 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.80 (P = 0.42)						
Total (95% CI)		**6740**		**6326**	**100.0%**	**1.03 [0.75, 1.42]**
Total events	80		94			
Heterogeneity: Tau² = 0.00; Chi² = 10.86, df = 13 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.19 (P = 0.85)						
Test for subgroup differences: Not applicable						

Risk Ratio
M-H, Random, 95% CI



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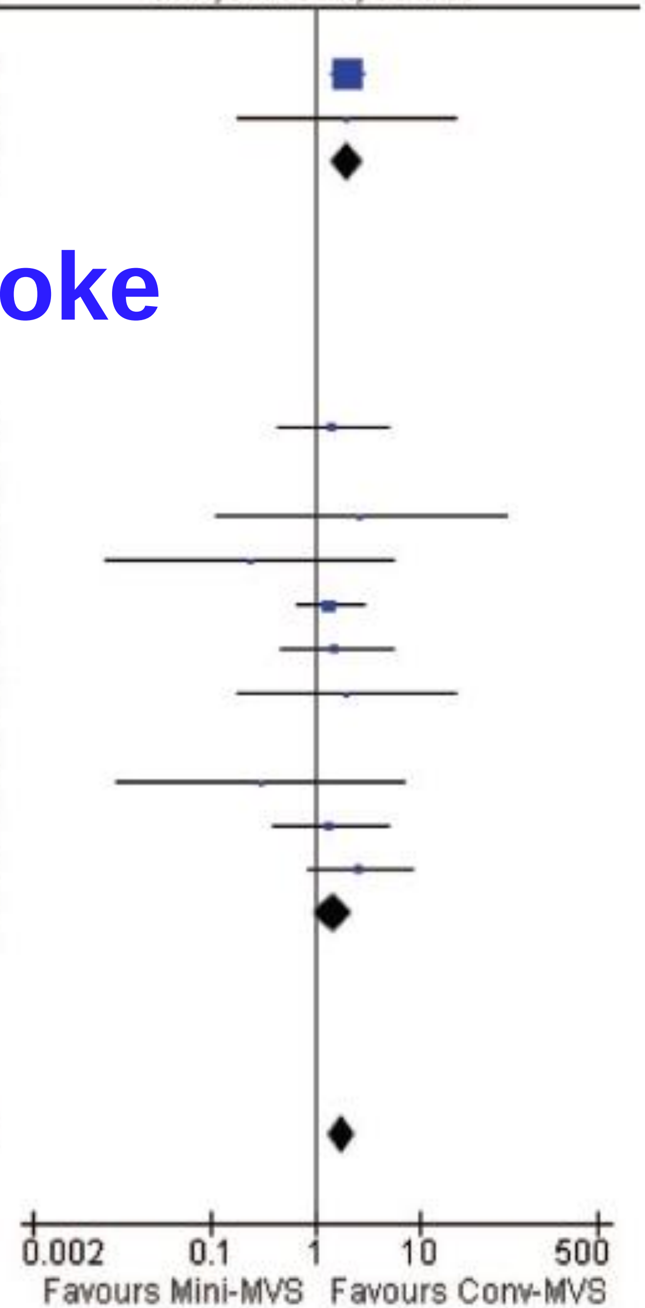
Stroke

Study or Subgroup	Mini-MVS Events	Mini-MVS Total	Conv-MVS Events	Conv-MVS Total	Weight	Risk Ratio M-H, Random, 95% CI
4.5.1 Propensity comparison						
Gammie 2010	81	4322	40	4322	57.8%	2.02 [1.39, 2.95]
MT-2010	2	106	1	106	1.4%	2.00 [0.18, 21.72]
Subtotal (95% CI)		**4428**		**4428**	**59.2%**	**2.02 [1.40, 2.94]**
Total events	83		41			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.00$, df = 1 (P = 0.99); $I^2 = 0\%$						
Test for overall effect: Z = 3.72 (P = 0.0002)						
4.5.2 Cohort						
Burfeind 2002	4	60	7	155	5.8%	1.48 [0.45, 4.86]
Chitwood 1997	0	31	0	100		Not estimable
Felger 2001ManCa	1	55	0	50	0.8%	2.73 [0.11, 65.57]
Felger 2001RobCa	0	72	1	50	0.8%	0.23 [0.01, 5.60]
Galloway 2009	25	1071	9	530	14.4%	1.37 [0.65, 2.92]
Gersak 2005	6	105	4	110	5.4%	1.57 [0.46, 5.41]
Grossi 2001a	2	100	1	100	1.4%	2.00 [0.18, 21.71]
Karagoz 1999a	0	54	0	29		Not estimable
Ryan 2010 Rpl	0	43	1	38	0.8%	0.30 [0.01, 7.04]
Ryan 2010 Rpr	6	172	4	159	5.3%	1.39 [0.40, 4.82]
Suri 2009	10	350	4	365	6.2%	2.61 [0.83, 8.24]
Subtotal (95% CI)		**2113**		**1686**	**40.8%**	**1.50 [0.96, 2.35]**
Total events	54		31			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.48$, df = 8 (P = 0.90); $I^2 = 0\%$						
Test for overall effect: Z = 1.77 (P = 0.08)						
Total (95% CI)		**6541**		**6114**	**100.0%**	**1.79 [1.35, 2.38]**
Total events	137		72			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 4.50$, df = 10 (P = 0.92); $I^2 = 0\%$						
Test for overall effect: Z = 3.99 (P < 0.0001)						
Test for subgroup differences: Not applicable						

Risk Ratio
M-H, Random, 95% CI

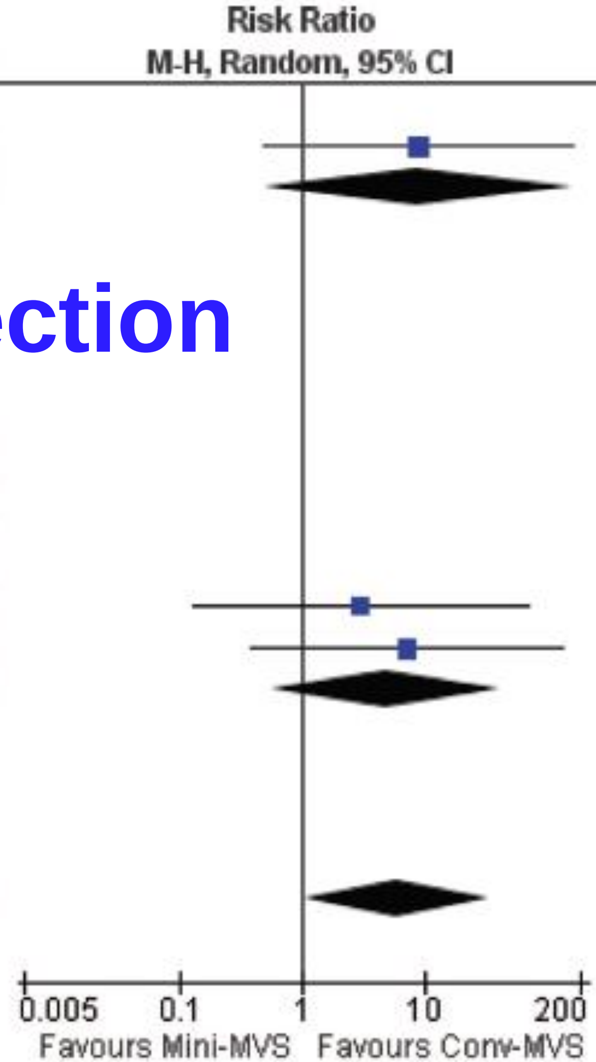


Minimally Invasive Versus Conventional Open Mitral Valve Surgery

A Meta-Analysis and Systematic Review

	Mini-MVS		Conv-MVS			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
5.22.1 Propensity comparison						
Gammie 2010	4	4322	0	4322	35.6%	9.00 [0.48, 167.11]
Subtotal (95% CI)		**4322**		**4322**	**35.6%**	**9.00 [0.48, 167.11]**
Total events	4		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.47 (P = 0.14)						
5.22.2 Cohort studies						
Bolotin 2004	0	38	0	33		Not estimable
Grossi 2001a	0	100	0	100		Not estimable
Grossi 2001b	0	69	0	52		Not estimable
Raanani 2010	0	61	0	82		Not estimable
Ryan 2010 Rpr	1	177	0	177	29.8%	3.00 [0.12, 73.15]
Suri 2009	3	350	0	365	34.7%	7.30 [0.38, 140.80]
Subtotal (95% CI)		**795**		**809**	**64.4%**	**4.84 [0.55, 42.43]**
Total events	4		0			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.16$, df = 1 (P = 0.69); $I^2 = 0\%$						
Test for overall effect: Z = 1.42 (P = 0.15)						
Total (95% CI)		**5117**		**5131**	**100.0%**	**6.04 [1.06, 34.47]**
Total events	8		0			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.28$, df = 2 (P = 0.87); $I^2 = 0\%$						
Test for overall effect: Z = 2.02 (P = 0.04)						
Test for subgroup differences: Not applicable						

Aortic dissection



UNIVERSITÀ DEGLI STUDI DI MILANO
FACOLTÀ DI MEDICINA E CHIRURGIA

Minimally Invasive Versus Open Mitral Valve Surgery

A Consensus Statement of the International Society of Minimally Invasive Coronary Surgery (ISMICS) 2010

Volkmar Falk, MD, Davy C. H. Cheng, MD,† Janet Martin, PharmD, MSc (HTA&M),†‡ Anno Diegeler, MD,§ Thierry A. Folliguet, MD,‖ L. Wiley Nifong, MD,¶ Patrick Perier, MD,§ Ehud Raanani, MD,# J. Michael Smith, MD,** and Joerg Seeburger, MD††*

"In patients with mitral valve disease, minimally invasive surgery may be an alternative to conventional mitral valve surgery (Class IIb), given that there was:

1. Comparable short-term and long-term mortality (level B)

2. Comparable in-hospital morbidity (renal, pulmonary, cardiac complications, pain perception, and readmissions) (level B)

3. Reduced sternal complications (0% vs 0.3%), transfusions (1.5 vs 3.5 RBC units), postoperative atrial fibrillation (18% vs 22%), duration of ventilation, and ICU and hospital length of stay (level B)."

Innovations • Volume 6, Number 2, March/April 2011

Minimally Invasive Versus Open Mitral Valve Surgery

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"However, this should be considered against the increased risk of:

4. Stroke (2.1% vs 1.2%) (level B)

5. Aortic dissection (0.2% vs 0%) (level B)

6. Phrenic nerve palsy (3% vs 0%) (level B)

7. Groin infections/complications (2% vs 0%) (level B)

8. Prolonged cross-clamp time, cardiopulmonary bypass time, and procedure time (level B)."

Innovations • Volume 6, Number 2, March/April 2011

A meta-analysis of minimally invasive versus conventional mitral valve repair for patients with degenerative mitral disease

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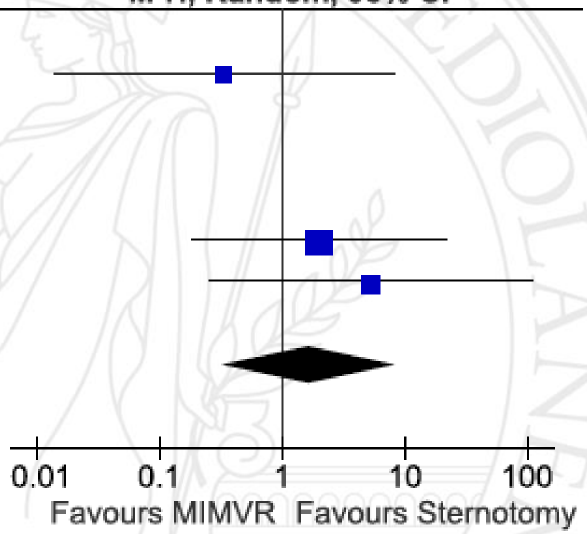
Christopher Cao[1], Sunil Gupta[1], David Chandrakumar[1], Thomas A. Nienaber[1], Praveen Indraratna[1], Su C. Ang[1], Kevin Phan[1,2], Tristan D. Yan[1,2]

Clinical outcomes	No. of studies	MIMVR (n)	Sternotomy (n)	Relative risk (95% CI)	P-value	I^2 (%)
Mortality	7	952	1,011	1.23 (0.22-6.88)	0.81	0
Cerebrovascular accidents*	6	906	929	1.43 (0.74-2.76)	0.29	0
Renal failure	3	284	305	0.96 (0.31-3.00)	0.95	0
Wound infection	4	634	670	2.97 (0.47-18.87)	0.25	29
Reoperation for bleeding	6	848	896	1.25 (0.60-2.62)	0.55	35
Aortic dissection	4	688	724	4.84 (0.55-42.43)	0.15	0
Myocardial infarction	3	284	305	1.15 (0.24-5.64)	0.86	0
Readmission within 30 days	2	308	315	0.61 (0.31-1.21)	0.16	0

Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
Goldstone 2013 myxo	0	153	0	153		Not estimable
Grossi 2001	0	100	1	100	25.6%	0.33 [0.01, 8.09]
Raanani 2010	0	61	0	82		Not estimable
Ruttman 2006	0	41	0	64		Not estimable
Ryan 2010	0	177	0	177		Not estimable
Speziale 2011	2	70	1	70	46.1%	2.00 [0.19, 21.56]
Suri 2009	2	350	0	365	28.3%	5.21 [0.25, 108.21]
Total (95% CI)		**952**		**1011**	**100.0%**	**1.66 [0.33, 8.33]**
Total events	4		2			

Heterogeneity: Tau² = 0.00; Chi² = 1.54, df = 2 (P = 0.46); I² = 0%
Test for overall effect: Z = 0.61 (P = 0.54)

M-H, Random, 95% CI



Mortality

Ann Cardiothorac Surg 2013;2(6):693-703

A meta-analysis of minimally invasive versus conventional mitral valve repair for patients with degenerative mitral disease

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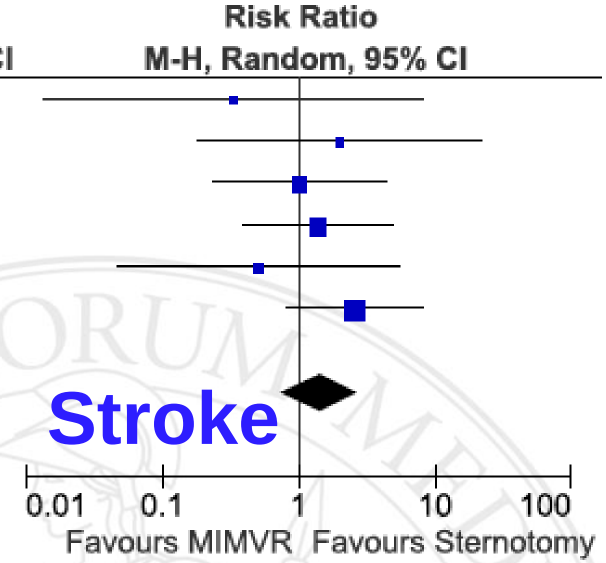
Christopher Cao[1], Sunil Gupta[1], David Chandrakumar[1], Thomas A. Nienaber[1], Praveen Indraratna[1], Su C. Ang[1], Kevin Phan[1,2], Tristan D. Yan[1,2]

	MIMVR		Sternotomy			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
Goldstone 2013 myxo	0	153	1	153	4.2%	0.33 [0.01, 8.12]
Grossi 2001	2	100	1	100	7.6%	2.00 [0.18, 21.71]
Raanani 2010	3	61	4	82	20.2%	1.01 [0.23, 4.34]
Ryan 2010	6	172	4	159	27.7%	1.39 [0.40, 4.82]
Speziale 2011	1	70	2	70	7.6%	0.50 [0.05, 5.39]
Suri 2009	10	350	4	365	32.6%	2.61 [0.83, 8.24]
Total (95% CI)		**906**		**929**	**100.0%**	**1.43 [0.74, 2.76]**
Total events	22		16			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.90$, $df = 5$ ($P = 0.72$); $I^2 = 0\%$
Test for overall effect: $Z = 1.07$ ($P = 0.29$)



Time-related outcomes	No. of studies	MIMVR (n)	Sternotomy (n)	Standard mean difference (95% CI)	P-value	I^2 (%)
Cross-clamp time	6	852	911	1.47 (0.52-2.42)	0.003	99
CPB time	6	952	1,011	1.46 (0.40-2.51)	0.007	99
ICU stay	2	247	247	–0.77 (–1.36-0.17)	0.01	88
Length of hospitalization	4	658	694	–0.24 (–0.65-0.18)	0.26	92

Ann Cardiothorac Surg 2013;2(6):693-703

What Is the Role of Minimally Invasive Mitral Valve Surgery in High-Risk Patients? A Meta-Analysis of Observational Studies

I.R.C.C.S.
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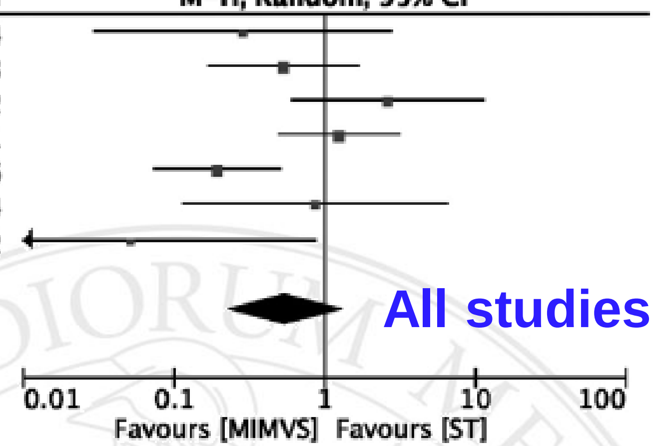
Marco Moscarelli, MD, Khalil Fattouch, MD, PhD, Roberto Casula, MD, Giuseppe Speziale, MD, PhD, Patrizio Lancellotti, MD, PhD, and Thanos Athanasiou, MD, PhD

A

Study or Subgroup	Favour MIMVS Events	Favour MIMVS Total	Favour ST Events	Favour ST Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Mihos 2014	1	22	4	28	9.5%	0.29 [0.03, 2.76]	2014
Tang 2013	5	90	9	90	17.9%	0.53 [0.17, 1.65]	2013
Iribarne 2012	5	70	3	105	15.0%	2.62 [0.60, 11.32]	2012
Holzhey 2011	11	143	9	143	20.0%	1.24 [0.50, 3.09]	2011
Sharony 2006	5	100	38	177	19.5%	0.19 [0.07, 0.51]	2006
Bolotin 2004	2	38	2	33	11.0%	0.86 [0.11, 6.48]	2004
Burfeind 2002	0	60	21	155	7.1%	0.05 [0.00, 0.87]	2002
Total (95% CI)		**523**		**731**	**100.0%**	**0.55 [0.23, 1.34]**	
Total events	29		86				

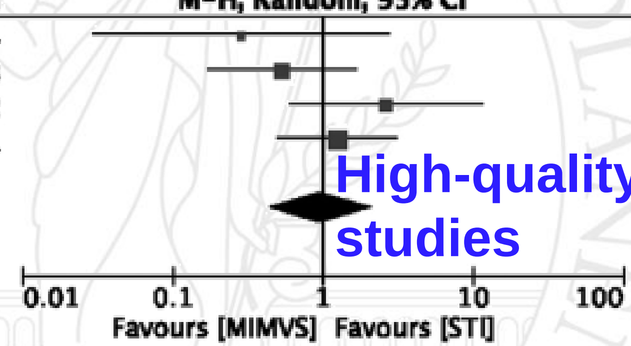
Heterogeneity: $Tau^2 = 0.80$; $Chi^2 = 15.90$, df = 6 (P = 0.01); $I^2 = 62\%$
Test for overall effect: Z = 1.32 (P = 0.19)



B

Study or Subgroup	Favour [MIMVS] Events	Favour [MIMVS] Total	Favour [ST] Events	Favour [ST] Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
Mihos 2014	1	22	4	28	10.2%	0.29 [0.03, 2.76]	2014
Tang 2013	5	90	9	90	30.0%	0.53 [0.17, 1.65]	2013
Iribarne 2012	5	70	3	105	21.0%	2.62 [0.60, 11.32]	2012
Holzhey 2011	11	143	9	143	38.8%	1.24 [0.50, 3.09]	2011
Total (95% CI)		**325**		**366**	**100.0%**	**0.97 [0.45, 2.10]**	
Total events	22		25				

Heterogeneity: $Tau^2 = 0.18$; $Chi^2 = 4.25$, df = 3 (P = 0.24); $I^2 = 29\%$
Test for overall effect: Z = 0.08 (P = 0.93)



ARTICLE IN PRESS

Mitral valve surgery: Right lateral minithoracotomy or sternotomy? A systematic review and meta-analysis

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Simon H. Sündermann, MD,[a] Juri Sromicki, MD,[a] Héctor Rodriguez Cetina Biefer, MD,[a,b] Burkhardt Seifert, MD, PhD,[c] Tomas Holubec, MD,[a] Volkmar Falk, MD, PhD,[a] and Stephan Jacobs, MD[a]

Objective: To update the current evidence on mitral valve surgery through a lateral minithoracotomy versus median sternotomy.

Methods: A comprehensive literature research was performed for studies comparing mitral valve surgery through a right lateral minithoracotomy (MIVS) and median sternotomy in MEDLINE, EMBASE, Cochrane Central, CTSnet, and Google Scholar for the most recent literature up to April 2013. A systematic review and meta-analysis was performed on the studies found in the literature.

Results: More than 20,000 patients from 45 studies were included in this study. Stroke rate and all-cause mortality up to 30 days was similar in both groups. The length of stay in the intensive care unit, respirator dependence, and hospital stay were significantly shorter in the MIVS group. Furthermore, blood drainage volume and blood transfusions were decreased in the MIVS group. In contrast, cardiopulmonary bypass time, crossclamp time, and procedure time were longer in the MIVS group. Postoperative new atrial fibrillation was less in the MIVS group. More aortic dissections occurred in the MIVS group. The rates of reexploration and postoperative renal failure were similar in both groups.

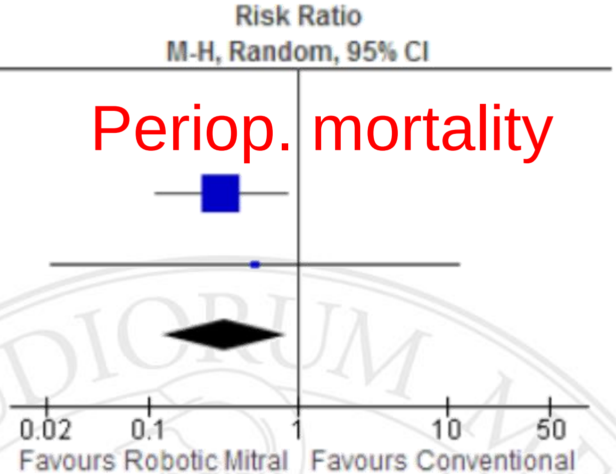
Conclusions: MIVS and conventional mitral valve surgery have a similar perioperative outcome. Mitral valve surgery via a right lateral minithoracotomy seems to be favorable with regard to resource-related outcome.
(J Thorac Cardiovasc Surg 2014;148:1989-95)

A meta-analysis of robotic *vs.* conventional mitral valve surgery

Christopher Cao[1], Hugh Wolfenden[2], Kevin Liou[3], Faraz Pathan[3], Sunil Gupta[1], Thomas A. Nienaber[1], David Chandrakumar[1], Praveen Indraratna[1], Tristan D. Yan[1,4]

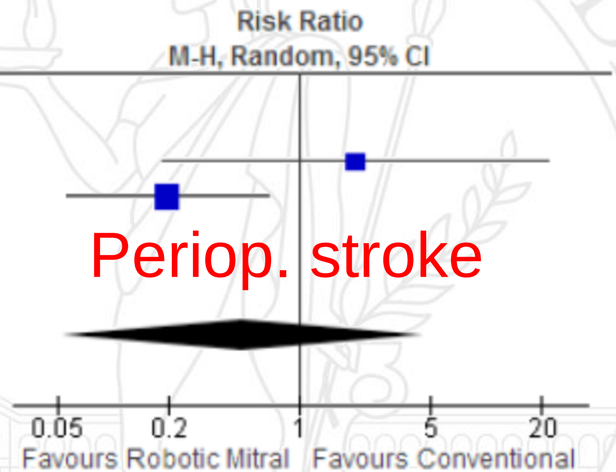
Study or Subgroup	Robotic Mitral Events	Robotic Mitral Total	Conventional Events	Conventional Total	Weight	Risk Ratio M-H, Random, 95% CI
Folliguet 2006	0	25	0	25		Not estimable
Kam 2010	0	107	0	40		Not estimable
Mihaljevic 2011	0	261	0	114		Not estimable
Stevens 2012	5	447	14	377	90.7%	0.30 [0.11, 0.83]
Suri 2011	0	95	0	95		Not estimable
Woo 2006	0	25	1	39	9.3%	0.51 [0.02, 12.12]
Total (95% CI)		**960**		**690**	**100.0%**	**0.32 [0.12, 0.83]**
Total events	5		15			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.10$, $df = 1$ ($P = 0.75$); $I^2 = 0\%$
Test for overall effect: $Z = 2.34$ ($P = 0.02$)



Study or Subgroup	Robotic Mitral Events	Robotic Mitral Total	Conventional Events	Conventional Total	Weight	Risk Ratio M-H, Random, 95% CI
Folliguet 2006	0	0	0	0		Not estimable
Kam 2010	0	0	0	0		Not estimable
Mihaljevic 2011	2	106	1	106	40.1%	2.00 [0.18, 21.72]
Stevens 2012	3	447	13	377	59.9%	0.19 [0.06, 0.68]
Suri 2011	0	95	0	95		Not estimable
Woo 2006	0	0	0	0		Not estimable
Total (95% CI)		**648**		**578**	**100.0%**	**0.50 [0.05, 4.65]**
Total events	5		14			

Heterogeneity: $Tau^2 = 1.77$; $Chi^2 = 2.88$, $df = 1$ ($P = 0.09$); $I^2 = 65\%$
Test for overall effect: $Z = 0.62$ ($P = 0.54$)



Ann Cardiothorac Surg 2015;4(4):305-314

Systematic review of robotic minimally invasive mitral valve surgery

Michael Seco[1,2], Christopher Cao[2,3], Paul Modi[4], Paul G. Bannon[1,2,3,5], Michael K. Wilson[5,6], Michael P. Vallely[1,2,5,6], Kevin Phan[3,5], Martin Misfeld[7], Friedrich Mohr[7], Tristan D. Yan[1,2,3,5]

0.0-9.1% for conversion to non-robotic surgery

106±22 to 188.5±53.8 min for CPB time

79±16 to 140±40 min for cross-clamp time

0.0-3.0% mortality

0.0-3.2% myocardial infarction

0.0-3.0% permanent stroke,

0.0-5.0% reoperations for bleeding

1.5-5.4% for early repair failure

DURABILITY?

81.7-97.6% no or trivial mitral regurgitation before discharge

Ann Cardiothorac Surg 2013;2(6):704-716

Minimally invasive mitral valve surgery: "The Leipzig experience"

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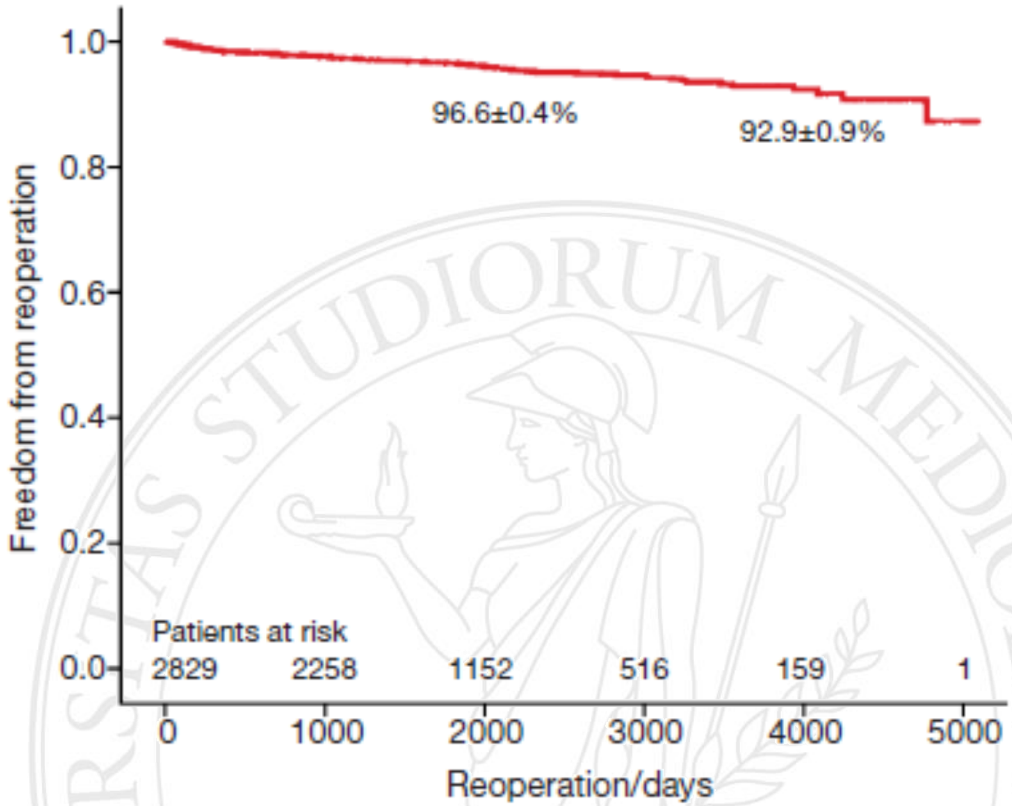
Piroze M. Davierwala, Joerg Seeburger, Bettina Pfannmueller, Jens Garbade, Martin Misfeld, Michael A. Borger, Friedrich W. Mohr

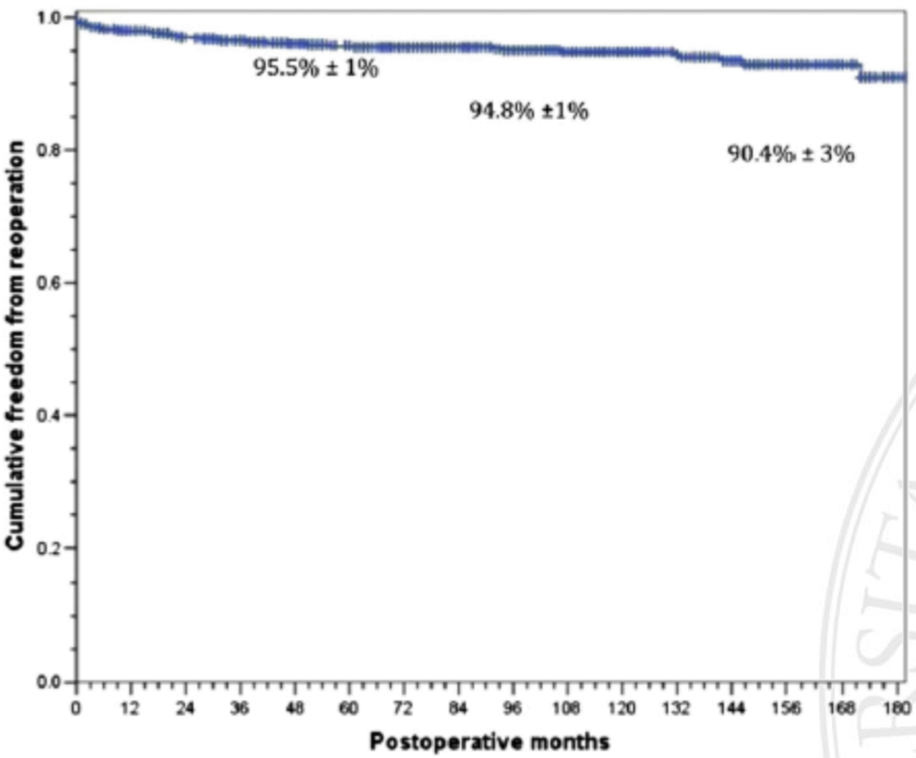
Intraoperative parameters	
Mitral valve repair†	2,829 (100)
Ring annuloplasty	2,829 (100)
Complete ring	2,440 (86.4)
Partial ring	389 (13.6)
Ring size	31.1±5.2
Combined procedures	
Tricuspid valve repair	303 (10.7)
Tricuspid valve replacement	4 (0.1)
Atrial septal defect/patent foreamen ovale closure	272 (9.6)
Cryoablation	793 (28)
Excision of cardiac tumors	3 (0.1)
Aortic cross-clamp time (minutes)	76.4±35.1
Cardiopulmonary bypass time (minutes)	133.6±68.6
Length of surgery (minutes)	180.1±133.6
Conversion to sternotomy	39 (1.4)
Mitral valve repair failure	45 (1.6)



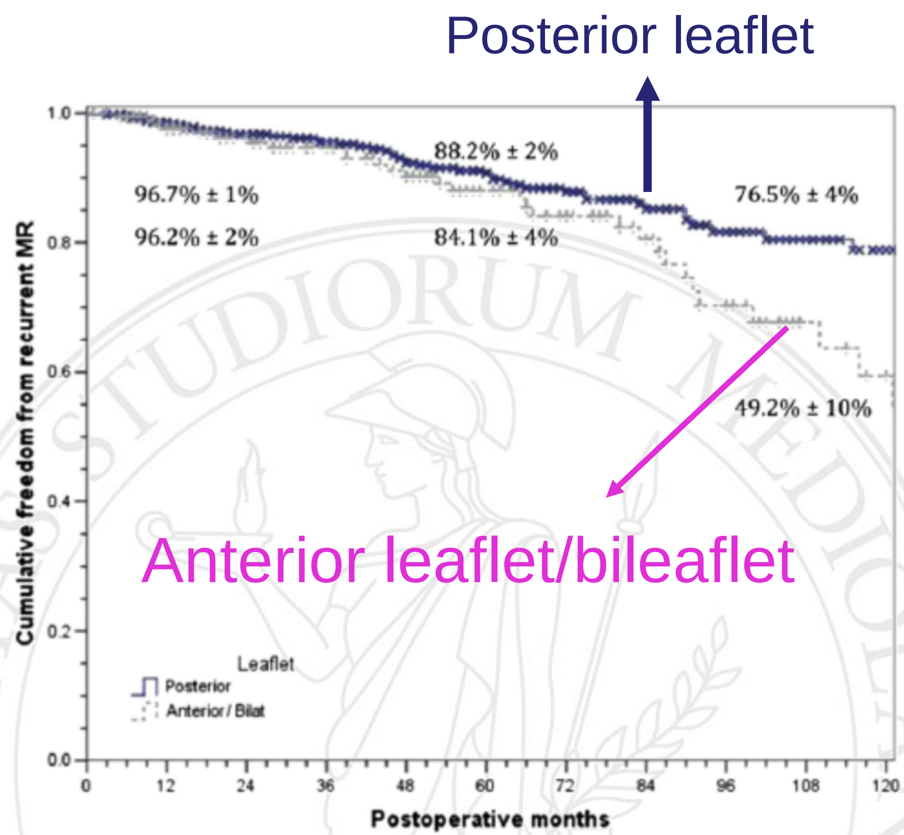
Ann Cardiothorac Surg 2013;2(6):744-750

One thousand minimally invasive mitral valve operations: Early outcomes, late outcomes, and echocardiographic follow-up

R. Scott McClure, MD, SM, FRCSC, Leonidas V. Athanasopoulos, MD, PhD, Siobhan McGurk, MSc, Michael J. Davidson, MD, Gregory S. Couper, MD, and Lawrence H. Cohn, MD



12	24	36	48	60	72	84	96	108	120	132	144	156	168	180
898	830	775	709	635	566	495	428	359	299	255	206	145	90	40

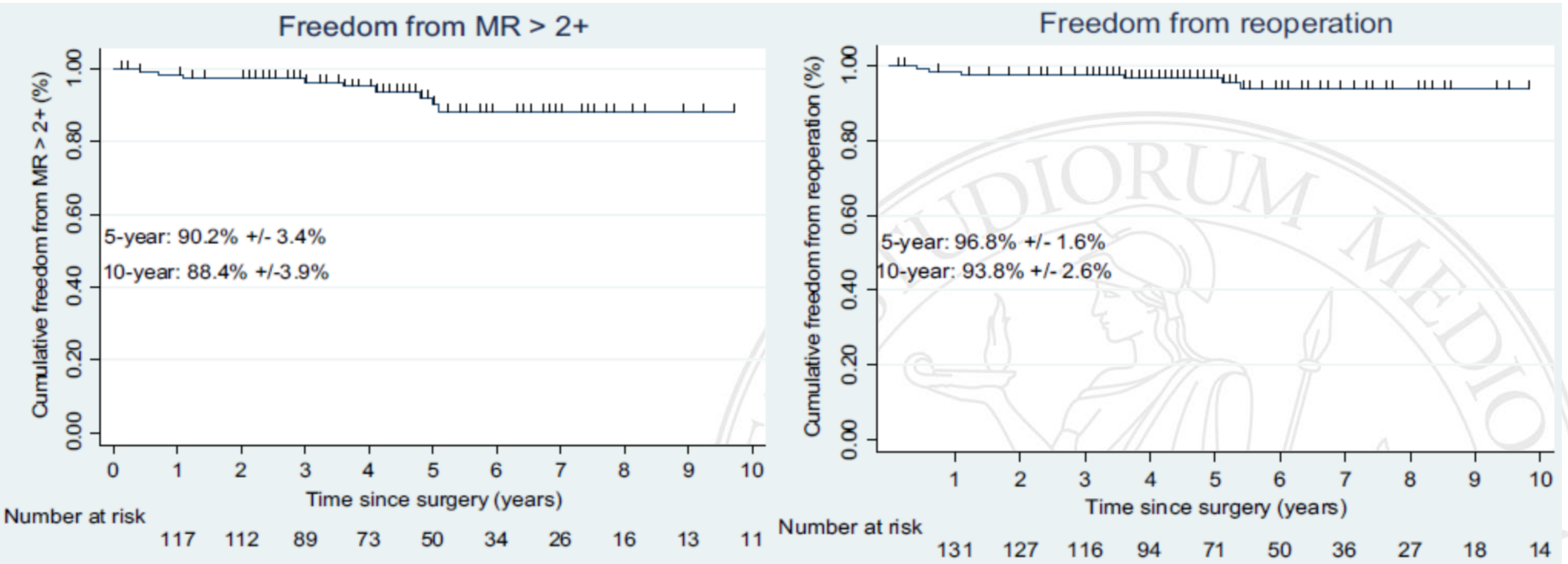


	12	24	36	48	60	72	84	96	108	120
Posterior	418	374	324	278	233	189	141	101	71	53
Anter /Bilat	170	145	123	108	87	68	53	41	25	16

J Thorac Cardiovasc Surg 2013;145:1199-206

Minimally invasive mitral valve repair in Barlow's disease: Early and long-term results

Michael A. Borger, MD, PhD, Anna F. Kaeding, MD, Joerg Seeburger, MD, PhD,
Serguei Melnitchouk, MD, Michael Hoebartner, MD, Michael Winkfein, MD,
Martin Misfeld, MD, PhD, and Friedrich W. Mohr, MD, PhD



Two different issues:

1. What is the gold standard in primary MV repair
2. What is the role of patient selection

Preoperative risk factors of medium-term mitral valve repair outcome

Jiangang Wang[a,*], Jie Han[a], Yan Li[a], Chunlei Xu[a], Yuqing Jiao[a], Bo Yang[b], Xu Meng[a] and Steven F. Bolling[b]

I.R.C.C.S.

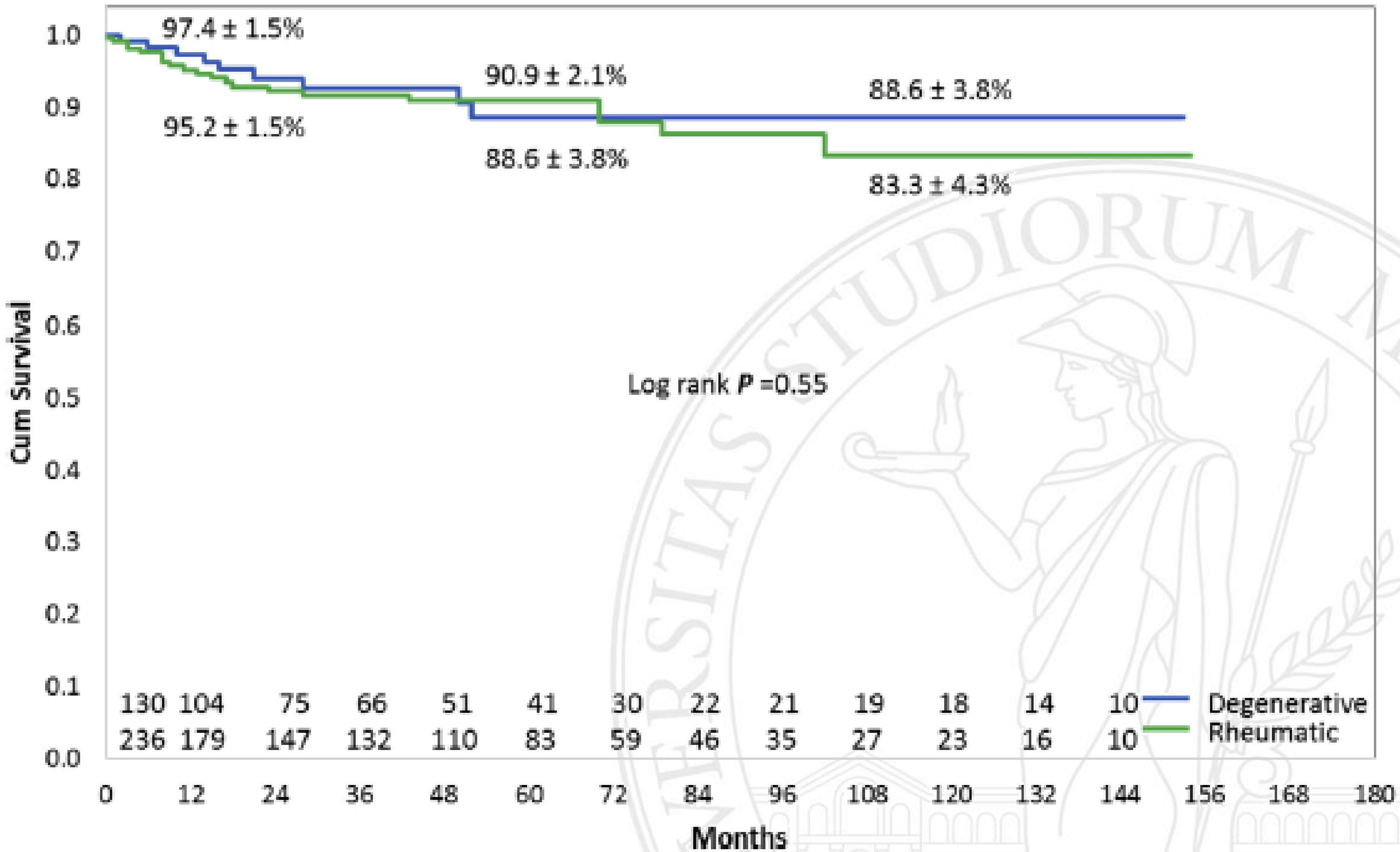
Table 3: Regression analysis

Variables	Univariate analysis			Multivariate analysis		
	HR/OR[a]	95% CI	*P*-value	HR/OR[a]	95% CI	*P*-value
Early mortality						
Age (by 5-year increments)	1.620	1.015–2.698	0.049	1.114	0.698–1.786	0.671
NYHA III/IV	2.347	1.482–4.663	0.001	2.154	1.428–4.296	0.016
AF	2.115	1.047–2.495	0.023	1.935	1.048–2.290	0.038
LVEF ≤50%	0.510	0.315–0.816	0.005	0.647	0.348–0.840	0.017
LVESD	1.089	0.995–1.156	0.051	1.068	0.674–1.185	0.434
TR grade	1.735	0.431–1.986	0.086	1.156	0.936–1.275	0.091
sPAP ≥50 mmHg	1.128	1.036–1.852	0.009	1.277	1.203–1.686	0.041
LCOS with ECMO	3.862	1.916–8.419	0.003	2.673	2.005–4.252	0.010
Renal failure	1.973	1.723–3.528	0.010	1.826	0.972–2.416	0.140
Late mortality						
Age (by 5-year increments)	1.135	1.102–1.783	0.010	1.052	0.972–1.218	0.117
NYHA III/IV	4.367	2.234–7.835	0.004	3.013	2.034–4.104	0.024
TR grade	2.016	0.735–4.763	0.079	1.283	0.943–2.556	0.061
LVEF ≤50%	0.901	0.743–1.962	0.062	0.869	0.976–1.701	0.102
AF	2.184	1.154–3.236	0.023	1.905	1.163–2.610	0.048
LVESD ≥40 mm	1.204	1.135–2.046	0.006	1.263	1.205–1.935	0.037
sPAP ≥50 mmHg	1.249	1.160–1.972	0.004	1.209	1.024–1.892	0.024
Reoperation						
Post-rheumatic	1.356	1.150–2.204	0.042	1.253	0.961–1.872	0.370
AL involvement	1.182	1.101–1.325	0.021	1.116	1.013–1.204	0.020
Edge-to-edge	2.354	0.384–3.105	0.092	1.486	0.853–1.936	0.057
Predischarge residual MR grade ≥2	1.063	1.014–2.095	0.020	1.020	1.009–1.641	0.027
Recurrent moderate-to-severe MR						
AL involvement	1.216	1.038–2.286	0.001	1.137	1.075–1.526	0.020
Edge-to-edge	1.135	0.417–2.041	0.071	1.101	0.937–1.201	0.060
Predischarge residual MR grade ≥2	1.312	1.216–1.946	0.017	1.085	1.079–1.103	0.033

Interactive CardioVascular and Thoracic Surgery 19 (2014) 946–954

Comparative long-term results of mitral valve repair in adults with chronic rheumatic disease and degenerative disease: Is repair for "burnt-out" rheumatic disease still inferior to repair for degenerative disease in the current era?

Jeswant Dillon, MD, FRCS,[a] Mohd Azhari Yakub, MBBS, FRCS,[a] Pau Kiew Kong, MBBS, FRCS,[a] Mohd Faizal Ramli, BSc, MSc,[b] Norfazlina Jaffar, BSc,[b] and Intan Fariza Gaffar, BSc[b]



J Thorac Cardiovasc Surg 2015;149:771-9

To be considered when choosing minimally invasive & robotic approaches

- extensive pleural adhesions (prior thoracotomy)
- poor pulmonary function
- aortic regurgitation
- pectus excavatum/chest wall deformities
- morbid obesity
- breast reconstruction
- chest radiation
- severe mitral annular calcification
- severe aorto-iliac disease

To be considered when choosing minimally invasive & robotic approaches

- renal failure
- liver dysfunction
- bleeding disorders
- PAPs > 60 mmHg
- coronary artery disease requiring surgery
- significant tricuspid valve disease
- recent (< 30 d) myocardial ischemia
- recent (< 30 d) stroke
- (high risk patients with comorbidities)
- poor ventricular function
- ……………

Is current evidence robust enough to recommend only minimally invasive/robotic MV repair??

- *Probably not yet but….we can make it!!!*
- *We still need more info on durability*
- *….we may (or may not) reach a satisfactory level of evidence in the years to come….*

My very personal reccomendations (not evidence-based)

- *BE SAFE!!!*
- *BE SAFE!!!*

- *Careful planning is essential*

- *Choose the technical options you are more familiar with*

- *Move to one technique to another step by step*

Thank you for your attention!

Comparative long-term results of mitral valve repair in adults with chronic rheumatic disease and degenerative disease: Is repair for "burnt-out" rheumatic disease still inferior to repair for degenerative disease in the current era?

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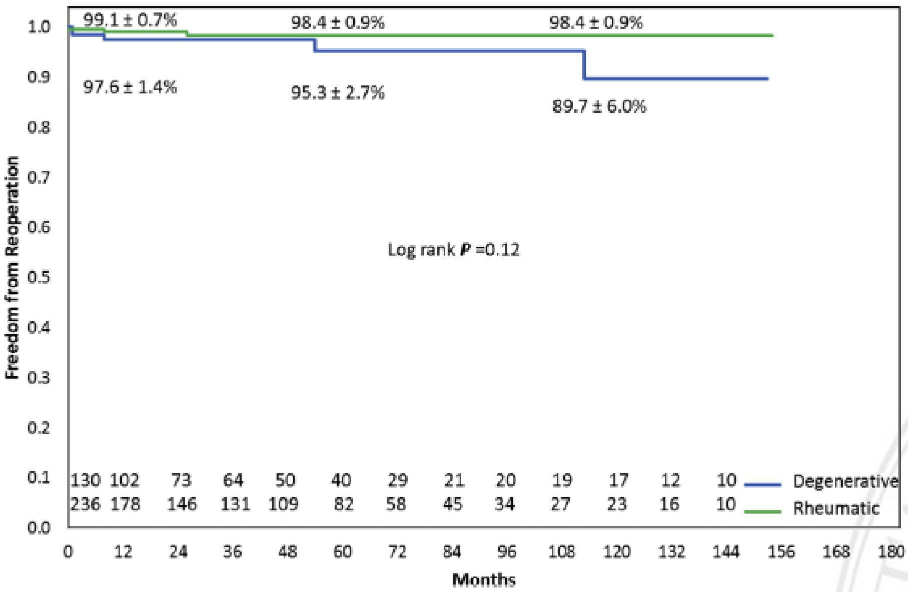

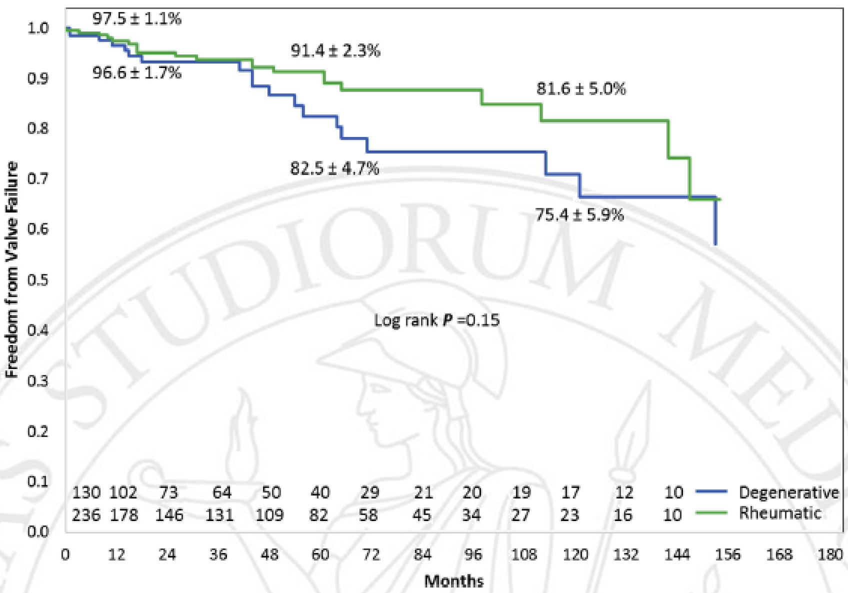

"The presence of residual mitral regurgitation greater than 2 before discharge was the only significant independent predictor of reoperation, whereas residual mitral regurgitation greater than 2 and leaflet procedures were significant risk factors for valve failure."

J Thorac Cardiovasc Surg 2015;149:771-9

Minimally invasive surgery(2)

Author	Year	Institution	Study Period	MIMVR (n)	Sternotomy (n)	Follow-up period (months)
Goldstone	2013	University of Pennsylvaniva, USA	2002-2011	153	153	50.4^{M}
Speziale	2011	Villa Azzurra Hospital & Anthea Hospital, Italy	2006-NR	70	70	12.4
Ryan	2010	Cardiopulmonary Research Science and Technology Institute, USA	1996-2008	177	177	62.4±34.8
Raanani	2010	Chaim Shebe Medical Centre, Israel	2000-2009	61	82	$41\pm24^{\dagger}; 28\pm22^{\S}$
Suri	2009	University of Pennsylvania (MIMVR) & Mayo Clinic (Sternotomy) , USA	1999-2006	350	365	NR
Ruttman	2006	Medical University of Innsbruck, Austria	2001-2005	42	64	$43.8^{\dagger}; 41.8^{\S}$
Grossi	2001	New York University School of Medicine, USA	1993-1999	100	100	33

MIMVR, minimally invasive mitral valve repair; NR, not reported; M, median; §, sternotomy; †, MIMVR.

Outcomes	Included studies			Overall statistics		
Clinical outcomes	No. of studies	MIMVR (n)	Sternotomy (n)	Relative risk (95% CI)	P-value	I^2 (%)
Mortality	7	952	1,011	1.23 (0.22-6.88)	0.81	0
Cerebrovascular accidents*	6	906	929	1.43 (0.74-2.76)	0.29	0
Renal failure	3	284	305	0.96 (0.31-3.00)	0.95	0
Wound infection	4	634	670	2.97 (0.47-18.87)	0.25	29
Reoperation for bleeding	6	848	896	1.25 (0.60-2.62)	0.55	35
Aortic dissection	4	688	724	4.84 (0.55-42.43)	0.15	0
Myocardial infarction	3	284	305	1.15 (0.24-5.64)	0.86	0
Readmission within 30 days	2	308	315	0.61 (0.31-1.21)	0.16	0
Time-related outcomes	No. of studies	MIMVR (n)	Sternotomy (n)	Standard mean difference (95% CI)	P-value	I^2 (%)
Cross-clamp time	6	852	911	1.47 (0.52-2.42)	0.003	99
CPB time	6	952	1,011	1.46 (0.40-2.51)	0.007	99
ICU stay	2	247	247	–0.77 (–1.36-0.17)	0.01	88
Length of hospitalization	4	658	694	–0.24 (–0.65-0.18)	0.26	92

MIMVR, minimally invasive mitral valve repair; CI, confidence interval; *, includes stroke with or without transient ischaemic attack; CPB, cardiopulmonary bypass; ICU, intensive care unit.

- *Minimally invasive techniques* aim to achieve *similar or superior safety and efficacy to conventional surgery* with the added advantages of reduced trauma, improved cosmesis and shorter hospitalization.
- Minimally invasive mitral valve surgery through a *video-assisted thoracotomy* approach was first *introduced in the mid-1990s.*

Ann Cardiothorac Surg. 2013 Nov; 2(6): 693–703.
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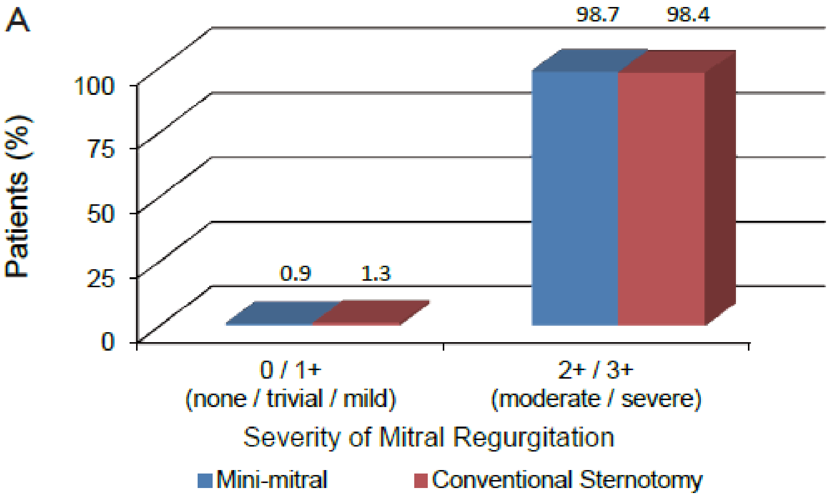
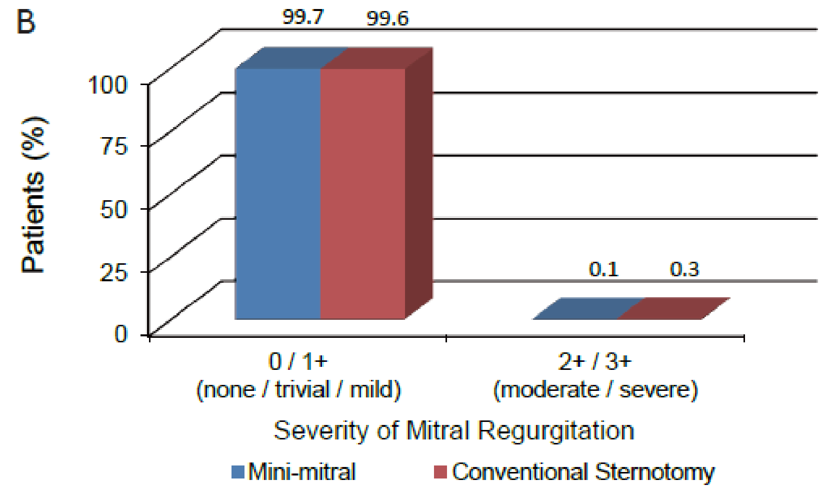
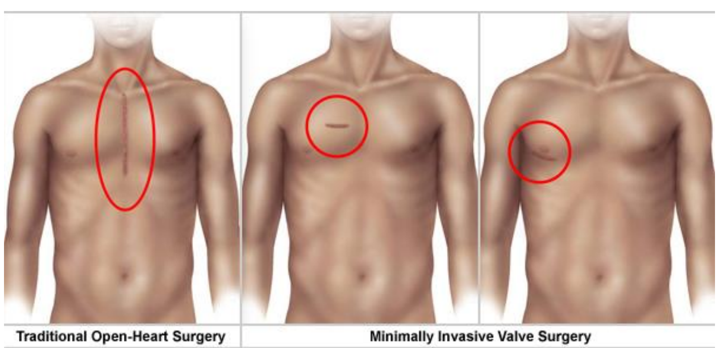
Minimally invasive surgery(3)





A summary of severity of *mitral regurgitation before (A) and after (B)* mitral valve repair through the minimally invasive (blue) or conventional sternotomy (red) approach.



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Minimally invasive surgery(4)

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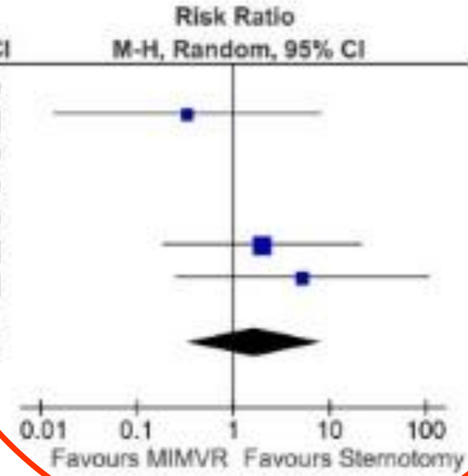
Study or Subgroup	MIMVR Events	MIMVR Total	Sternotomy Events	Sternotomy Total	Weight	Risk Ratio M-H, Random, 95% CI
Goldstone 2013 myxo	0	153	0	153		Not estimable
Grossi 2001	0	100	1	100	25.6%	0.33 [0.01, 8.09]
Raanani 2010	0	61	0	82		Not estimable
Ruttman 2006	0	41	0	64		Not estimable
Ryan 2010	0	177	0	177		Not estimable
Speziale 2011	2	70	1	70	46.1%	2.00 [0.19, 21.56]
Suri 2009	2	350	0	365	28.3%	5.21 [0.25, 108.21]
Total (95% CI)		**952**		**1011**	**100.0%**	**1.66 [0.33, 8.33]**
Total events	4		2			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.54$, df = 2 (P = 0.46); $I^2 = 0\%$
Test for overall effect: Z = 0.61 (P = 0.54)



<u>Forest plot of the relative risk (RR) of perioperative mortality after minimally invasive mitral valve repair (MIMVR) versus conventional sternotomy repair for degenerative mitral valve disease.</u>

The estimate of the RR of each trial corresponds to the middle of the squares, and the horizontal line shows the 95% confidence interval (CI). On each line, the numbers of events as a fraction of the total number treated are shown for both treatment groups. For each subgroup, the sum of the statistics, along with the summary RR, is represented by the middle of the solid diamonds. A test of heterogeneity between the trials within a subgroup is given below the summary statistics.

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Minimally invasive surgery(5)

I.R.C.C.S.
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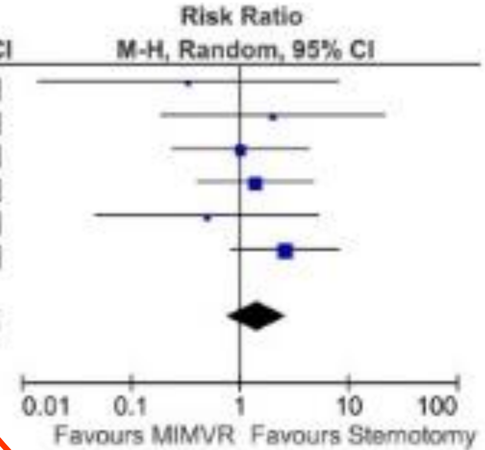
Study or Subgroup	MIMVR Events	MIMVR Total	Sternotomy Events	Sternotomy Total	Weight	Risk Ratio M-H, Random, 95% CI
Goldstone 2013 myxo	0	153	1	153	4.2%	0.33 [0.01, 8.12]
Grossi 2001	2	100	1	100	7.6%	2.00 [0.18, 21.71]
Raanani 2010	3	61	4	82	20.2%	1.01 [0.23, 4.34]
Ryan 2010	6	172	4	159	27.7%	1.39 [0.40, 4.82]
Speziale 2011	1	70	2	70	7.6%	0.50 [0.05, 5.39]
Suri 2009	10	350	4	365	32.6%	2.61 [0.83, 8.24]
Total (95% CI)		**906**		**929**	**100.0%**	**1.43 [0.74, 2.76]**
Total events	22		16			

Heterogeneity: Tau² = 0.00; Chi² = 2.90, df = 5 (P = 0.72); I² = 0%
Test for overall effect: Z = 1.07 (P = 0.29)



Forest plot of the relative risk (RR) of cerebrovascular accidents after minimally invasive mitral valve repair (MIMVR) versus conventional sternotomy repair for degenerative mitral valve disease.

The estimate of the RR of each trial corresponds to the middle of the squares, and the horizontal line shows the 95% confidence interval (CI). On each line, the numbers of events as a fraction of the total number treated are shown for both treatment groups. For each subgroup, the sum of the statistics, along with the summary RR, is represented by the middle of the solid diamonds. A test of heterogeneity between the trials within a subgroup is given below the summary statistics

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Minimally invasive surgery(6)

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Since then, a number of large studies have *demonstrated the feasibility of performing minimally invasive mitral valve repair (MIMVR) for* *selected patients* in specialized centres. Despite encouraging institutional reports, broad adoption of the MIMVR technique has been limited.

Although previous meta-analyses reported *superior perioperative outcomes for minimally invasive mitral valve surgery compared to the conventional sternotomy approach*, limited attempts were made to differentiate repair versus replacement procedures and account for the significant variations in the underlying valvular pathology.

In addition, some surgeons remain concerned about the limited *exposure of the mitral valve, arterial injuries* and difficulties in deairing the heart that may result in an increased *incidence of cerebrovascular accidents*.

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Minimally invasive surgery(7)

Table 4 A summary of surgical techniques performed during mitral valve surgery through mini-mitral or sternotomy approaches

Author	Mini-mitral access approach	Mini-mitral clamp technique	Cardioplegia		Mitral-valve repair details		Concomitant surgery		Conversion to sternotomy
			Mini	Stern	Mini-mitral	Sternotomy	Mini-mitral	Sternotomy	
Goldstone	4 cm right thoracotomy in infra-mammary grove	Aortic cross-clamp or endoballoon	AG & RG		Annuloplasty (5/153); leaflet resection (98/153); neochordae (29/153)	Annuloplasty (10/153); leaflet resection (121/153); neochordae (15/153)	NR	NR	NR
Speziale	2 ports & 4-5 cm right anterolateral mini-thoracotomy 3rd ICS & 5-7th ICS	Aortic cross-clamp	AG	NR	Annuloplasty & artificial chordal re-implantation	Annuloplasty & artificial chordal re-implantation	AF ablation (11/70)	AF ablation (12/70)	1/70 (inadequate exposure)
Ryan	4 cm incision 4th right ICS with port access	Endoballoon	AG & RG		Annuloplasty, chordal replacement and/or leaflet resection and sliding-plasty as required	Annuloplasty, chordal replacement and/or leaflet resection and sliding-plasty as required	NR	NR	2/177 (repair of coronary sinus)

NO statistically significant differences between MIMVR and conventional mitral valve repair in regards to mortality, stroke, renal failure, wound infection, reoperation for bleeding, aortic dissection, myocardial infarction, atrial fibrillation, or readmission within 30 days.

The duration of ICU stay was shorter for patients who underwent MIMVR, but there was no significant difference between the two approaches in the duration of hospitalization.

Minimally invasive surgery(8)

The incidence of moderate/severe MR dropping from 98.7% and 98.4% preoperatively to 0.1% and 0.3% postoperatively comparing MIMVR with the conventional sternotomy approach.

In conclusion, the present meta-analysis comparing MIMVR with the conventional sternotomy approach for patients with degenerative mitral valve disease requiring repair did not identify any statistically significant difference in regards to perioperative clinical outcomes.

Patients who underwent MIMVR required significantly longer periods of cross-clamping and cardiopulmonary bypass. However, patients who underwent the minimally invasive approach had a significantly shorter ICU stay period, although this was not translated into a shorter hospitalization duration.

Although previous studies claim MIMVR results in reduced pain and quicker recovery, there appears to be a relative paucity of evidence to support these claims. Only one study reported improved pain outcomes for patients who underwent MIMVR within the first week postoperatively.

In view of the learning curve and multi-disciplinary training required to develop and maintain a successful MIMVR program, these procedures should currently be limited to specialist centres until more robust evidence supports broader adoption of this surgical technique.

Future studies should aim to attain longer clinical and echocardiographic follow-up in a randomized setting.

Table 1: Review of percutaneous mitral valve repair trials

Trials	Method	Efficacy	Safety
EVEREST	Single arm study to evaluate the feasibility and safety of mitral clip (*n*=107)	66% met the composite end-point of improved MR, freedom from cardiac surgery and freedom from death	104 were discharged home 5 patients had bleeding, 3 had atrial septal complications
EVEREST II	279 patients with moderately severe to severe MR (almost half functional) randomized 2:1 percutaneous repair vs. conventional surgery	Effective at reducing MR Lower 30 days mortality Long durability up to 24 months Improved quality of live More frequent additional procedures	Less adverse events and Less blood transfusion in the mitral clip arm
TITAN	The impact of mitral annuloplasty on functional MR in 36 patients	Improvement in 6MWD and Kansas City Cardiomyopathy Questionnaire Improvement in LV geometry	No device related complications reported

MR: Mitral regurgitation, LV: Left ventricular