



Background

- Minimally invasive (MIS) mitral valve surgery (MVS) offers many benefits including expedited patient recovery with shorter ICU and hospital stays, fewer blood transfusions, enhanced patient satisfaction, and reduced healthcare costs¹.
- Despite advancements in the MIS MVS field, a gap remains in our understanding of long-term outcomes for this patient population. Existing studies^{2,3}, while informative, often focus on mortality rates and rates of re-operations.
- This paper aims to characterize the mid- and long-term echocardiographic characteristics in the MIS mitral valve repair (MVR) population.

Methods

- Retrospective review of all records of all 208 adult patients who underwent MIS MVR at our institution between 2006-2021.
- The repair’s durability was assessed intraoperatively, at 1-year, 1-3 years, 3-5 years, and 5+ years follow-up post-operation.
- The surgical technique involved a mini-thoracotomy, femoral cannulation, antegrade & retrograde cardioplegia, and valve repair with annuloplasty ring placement by a single surgeon (R.C.).
- Outcomes included: (1) post-operative mortality, (2) complications, (3) post-operative moderate-to-severe (grade 3) or severe (grade 4) MR, (4) and post-operative ejection fraction (EF).

Results

- 208** patients: **26% females**, median age **61 years**. **9 (4.3%)** had **previous cardiac surgery** and **65 (34.8%)** presented with **NYHA III/IV** heart failure.
- Intraoperative outcomes** are summarized in **Table 1**.
- Isolated P2 repair** was the most common type of repair (31.3%) and **Neochords** were used in 40.4% of cases.
- All patients received an annuloplasty ring**.
- Post-operative dynamic systolic anterior motion (**SAM**) was found in **6 (2.9%)** cases and **chordal SAM** in **13 (6.3%)** cases. **One** required **intra-operative re-repair**, while all the others resolved with hemodynamic optimization.

Peri-operative outcomes are summarized in **Table 2**.

	N, (%)
Repair Type, n (%)	
Neochord Use	84 (40.4)
Isolated P2 Repair	65 (31.3)
Anterior Leaflet Repair	14 (6.7)
Commissure Repair	12 (5.8)
Ring Annuloplasty, n (%)	
CE Physio	24 (11.6)
CE Physio II	175 (84.1)
St. Jude Seguin	9 (4.3)
Post-operative SAM, n (%)	
Dynamic	6 (2.9)
Chordal	13 (6.3)
OR time (min), median (IQR)	305.0 (271.0-347.0)
CPB time (min), median (IQR)	182.0 (154.0-203.0)
XC time (min), median (IQR)	133.0 (108.0-154.0)

Table 1. Intraoperative Outcomes

Outcome	N, (%)
Reoperation for Bleeding, n (%)	5 (2.4)
Acute Kidney Injury, n (%)	3 (1.4)
Major Wound Infection, n (%)	0 (0.0)
Cerebrovascular Accidents, n (%)	0 (0.0)
Red Blood Cell Transfusion, n (%)	28 (13.5)
Post Operative Atrial Fibrillation, n (%)	46 (22.1)
Hospital Length of Stay (days), median (IQR)	6.0 (5.0-7.0)

Table 2. Perioperative Outcomes

Mid-term follow-up echocardiographic outcomes are summarized in **Table 3**.

- Overall, **10 (4.8%)** patients **developed grade 3-4 MR**: **2** died, **4** had subsequent MV replacement, **4** were managed medically.
- Freedom from MVR failure** at 10 years was **95.2±1.5%**.
- Freedom from grade 4 TR development** over 10 years was **98.6±0.8%**.
- No** statistically significant **change in EF** at 5+ years follow-up (**57.1±7.9% vs 57.9±6.9%, p=0.90**).

Variables	Pre-operative (n=205)	Within 1 year (n = 205)	1-3 years (n = 142)	3-5 years (n = 116)	5+ years (n = 104)
LVEF (%), mean ± SD					
LVEF (%)	57.1±7.9	53.8±8.3	56.2±7.8	56.4±6.8	57.0±6.9
LVEF Grouped, n (%)					
LVEF ≤ 60%	144 (69.2)	178 (86.8)	108 (76.1)	95 (81.9)	80 (76.9)
LVEF > 60%	61 (29.3)	27 (13.2)	34 (23.9)	21 (18.1)	24 (23.1)
MR Grade, mean ± SD					
MR Grade	3.8±0.5	1.0±0.5	1.0±0.6	1.0±0.6	1.1±0.5
MR Grade, n (%)					
None (0)	0 (0.0)	18 (8.8)	16 (11.3)	12 (10.3)	8 (7.7)
Trivial/Mild (1)	1 (0.5)	173 (84.4)	108 (76.0)	93 (80.2)	78 (75.0)
Moderate (2)	6 (2.9)	12 (5.8)	15 (10.6)	7 (6.0)	16 (15.4)
Moderate-Severe (3)	29 (14.0)	0 (0.0)	3 (2.1)	3 (2.6)	2 (1.9)
Severe (4)	171 (82.6)	2 (1.0)	0 (0.0)	1 (0.9)	0 (0.0)
TR Grade, mean ± SD					
TR Grade	1.1±0.6	1.2±0.5	1.2±0.6	1.2±0.6	1.2±0.6
TR Grade, n (%)					
None (0)	27 (13.1)	4 (2.0)	6 (4.2)	4 (3.4)	7 (6.7)
Trivial/Mild (1)	147 (71.4)	156 (76.0)	111 (78.2)	91 (78.5)	72 (69.2)
Moderate (2)	29 (14.0)	43 (21.0)	23 (16.2)	18 (15.5)	22 (21.2)
Moderate-Severe (3)	1 (0.5)	1 (0.5)	0 (0.0)	1 (0.9)	2 (1.9)
Severe (4)	2 (1.0)	1 (0.5)	2 (1.4)	2 (1.7)	1 (1.0)

Table 3. Mid-term follow up echocardiographic LVEF, mitral and tricuspid regurgitation data

Survival and Re-operation curves are illustrated in **Figure 1 & Figure 2**.

- Survival rates** were: 100.0±0.0% at 30 days, 97.6±1.1% at 5 years and 92.8±1.8% at 10 years.
- Freedom from re-operation** at 5 years was 98.6±0.8% and at 10 years was 97.6±1.1%.

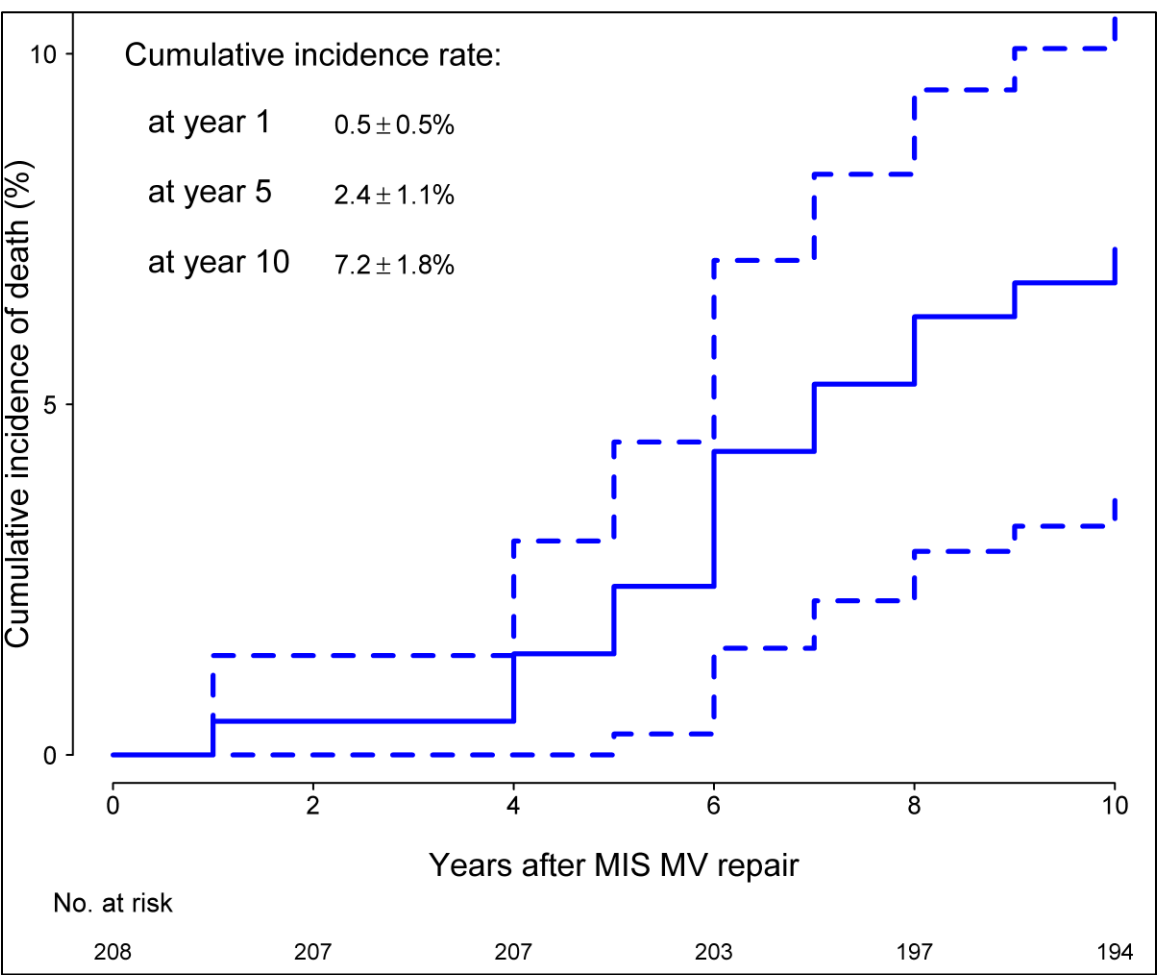


Figure 1. Cumulative rate curve of death rates over a 10 years

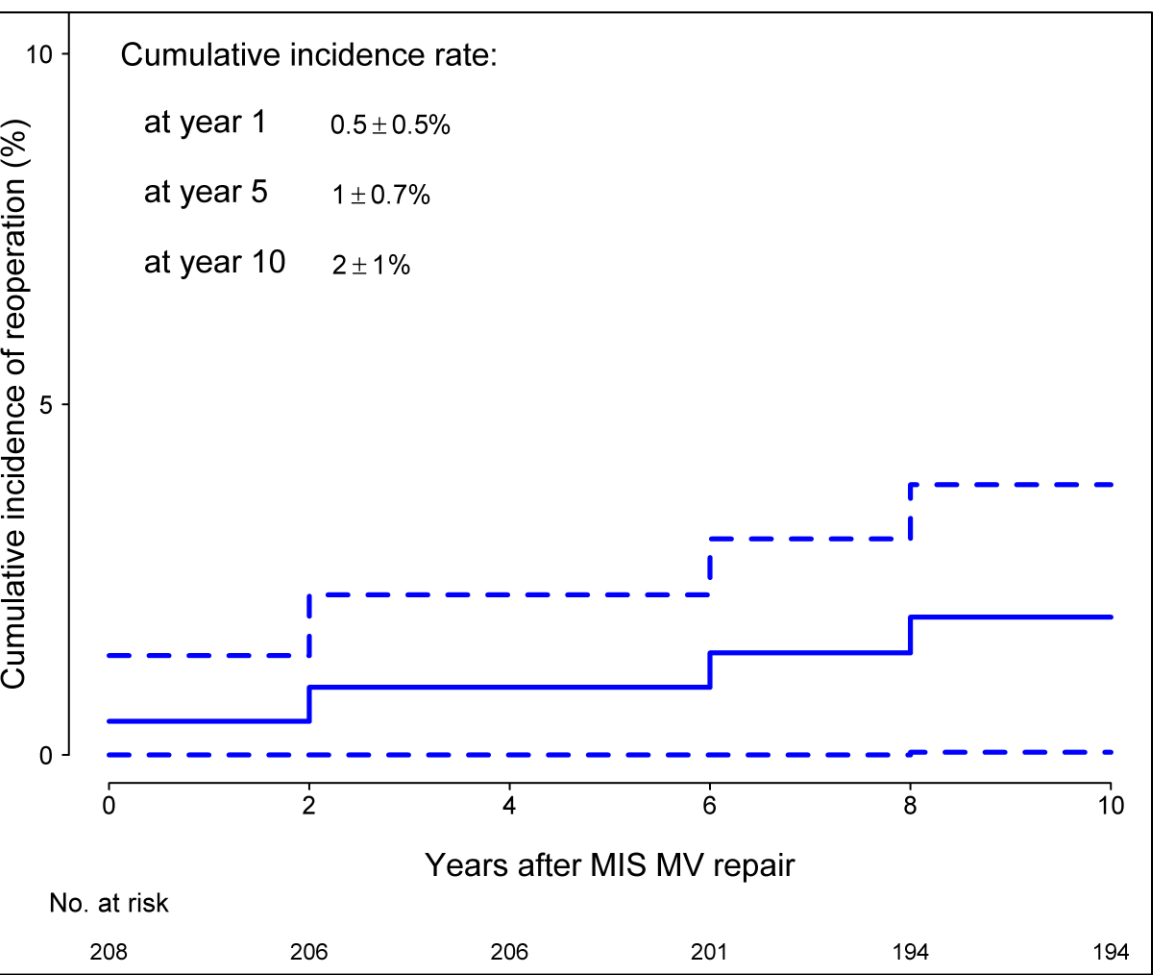


Figure 2. Cumulative rate curve of MV re-operation rates over 10 years

Conclusion

- We have observed that MIS MVR was associated with a **high repair rate**, with **very low peri-operative mortality**, **excellent long-term survival**, **high rates of freedom of re-operation** and **freedom from grade 3-4 MR and grade 4 TR at 5+ years**.
- Further follow-up is ongoing to determine long-term outcomes in this patient cohort.

¹ Cohn, L. H., Adams, D. H., Couper, G. S., Bichell, D. P., Rosborough, D. M., Sears, S. P., & Aranki, S. F. Minimally invasive cardiac valve surgery improves patient satisfaction while reducing costs of cardiac valve replacement and repair. Annals of surgery, 1997; 226(4): 421–428.

² Galloway AC, Schwartz CF, Ribakove GH, et al. A decade of minimally invasive mitral repair: long-term outcomes. Ann Thorac Surg. 2009;88(4):1180-1184.

³ McClure RS, Athanasopoulos LV, McGurk S, Davidson MJ, Couper GS, Cohn LH. One thousand minimally invasive mitral valve operations: early outcomes, late outcomes, and echocardiographic follow-up. J Thorac Cardiovasc Surg. 2013;145(5):1199-1206.

