# 5 Year Outcomes Of Robotic versus Non-Robotic Mitral Valve Repair: A Propensity-Score Matched TriNetX Multicenter Retrospective Analysis

Abdullah W. Saleh, BS; Ismail Khaderi, BS; Moussa Shahoud, BS; Andrew Vogel, MD; Nesreen Shahrour, BS; Nathaniel Haynes, BS; Abe DeAnda, MD; Aurelie Merlo, MD

School of Medicine

## BACKGROUND

- Mitral valve (MV) repair is the gold standard for degenerative mitral regurgitation, and robotic-assisted approaches have grown from **10.9% to 14.6%** of repairs in the STS database (2015–2021). [1]
- National database studies demonstrate that robotic repair achieves comparable mortality **with lower perioperative morbidity**, including reduced conversion to replacement (1.0–1.2% vs 3.1–3.7%) and shorter hospital stays. [1]
- **However, existing comparative evidence is limited to perioperative or short-term outcomes**, restricted to Medicare-age populations (mean age 72 years), or derived from single-center series lacking direct comparison with non-robotic approaches. [1, 2, 3]
- Long-term outcomes — including new-onset atrial fibrillation, major adverse cardiovascular events (MACEs), all-cause mortality, and reoperations — have not been comprehensively evaluated in a multicenter analysis across the full age spectrum.

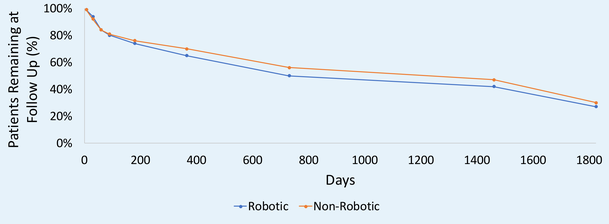
**Objective:** Compare up to 5-year outcomes of robotic vs non-robotic MV repair, including new-onset atrial fibrillation (AF), all-cause mortality, MACEs, and mitral reoperation, in adults with non-rheumatic mitral valve disease using the TriNetX federated research network.

## METHODS

- **Data source:** TriNetX Federated Research Network (>165M patients across 115 healthcare organizations) with longitudinal, encounter-level follow-up.
- **Cohort:** Adults ≥18 yrs with non-rheumatic mitral valve disease (ICD-10: I34) undergoing primary MVR (CPT 1014130) between Jan 2014 and Nov 2025.
- **Exclusions:** Prior cardiac surgery, prior stroke/TIA, or infective endocarditis.
- **Matching:** 1:1 nearest-neighbor propensity-score matching on 33 covariates (caliper 0.1 SD of the logit).
- **Outcomes:** New-onset AF, all-cause mortality, MACE (cardiac arrest, MI, cerebral infarction/TIA, HF, intracranial hemorrhage), and mitral reoperation, assessed at 1 week; 1, 2, 3, 6 months; and 1, 2, 3, 5 years.
- **Analysis:** $\chi^2$ / Fisher's exact tests with risk ratios and 95% CIs per time point. Kaplan–Meier survival with log-rank testing. Two-sided $p < 0.05$ was considered significant.

## PROPENSITY SCORE MATCHING

- **Demographics:** age, sex, race/ethnicity
- **Anthropometrics:** body weight, BMI
- **Cardiovascular:** preoperative atrial fibrillation, hypertension, ischemic heart disease, heart failure, cardiomyopathy, pulmonary hypertension, other arrhythmias, cardiomegaly, dyslipidemias, atherosclerosis, peripheral vascular disease
- **Metabolic:** diabetes mellitus, overweight/obesity
- **Other:** tobacco/nicotine use, neoplasms, cerebrovascular disease
- **Laboratory:** LVEF, HbA1c, BNP/pro-BNP




## RESULTS

**15,437 patients** met eligibility criteria (1,349 robotic / 14,088 non-robotic). After 1:1 PSM on 33 covariates: **1,344 patients per cohort remained** (all SMDs <0.10 for major covariates).

Mean age 61.3 ± 11.8 (R) vs 61.2 ± 12.9 yr (NR); Male 63.9% vs 64.2%; Preop AF 28.0% vs 28.5%; Concomitant AF ablation 56% vs 61%.

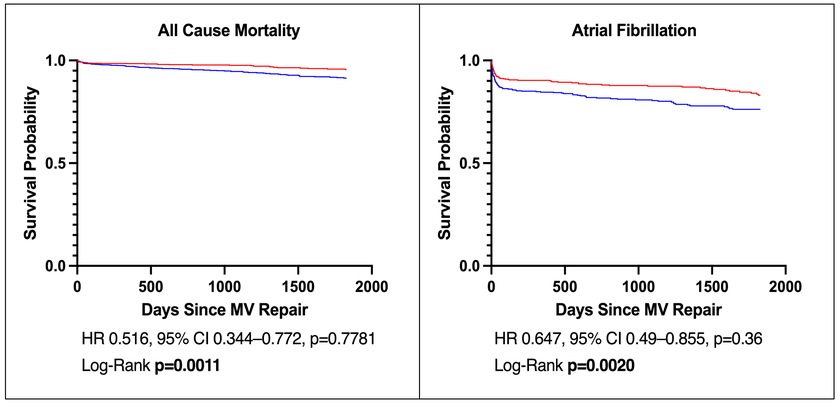
**Mean follow-up:** 909 ± 724 d (robotic) vs 1,001 ± 722 d (non-robotic).

**Primary Outcomes (Matched Cohorts, n = 1,344 per group)**

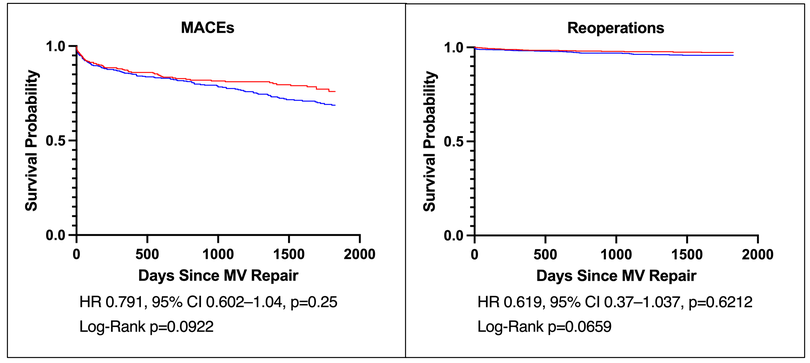
| Outcome | Time | Robotic | Non-Robotic | p-value | RR (95% CI) |
|---|---|---|---|---|---|
| New Onset AFib | 1 week | 4.545% | 7.559% | **0.0202** | 0.601 (0.39-0.928) |
| | 6 months | 9.23% | 13.86% | **0.0079** | 0.666 (0.493-0.901) |
| | 5 years | 86, 12.22% | 117, 18.43% | **0.0016** | 0.663 (0.513–0.857 ) |
| All-cause mortality | 5 years | 35, 2.61% | 72, 5.36% | **0.0003** | 0.473 (0.313–0.713) |
| MACE (composite) | 5 years | 81, 15.37% | 142, 20.06% | **0.0342** | 0.766 (0.598–0.983) |
| Mitral reoperation | 5 years | 23, 1.71% | 39, 2.90% | **0.0398** | 0.590 (0.35–0.98) |

*RR = Risk Ratio; CI = Confidence Interval; MACE = composite of cardiac arrest, MI, stroke/TIA, HF, or intracranial hemorrhage.*

## KAPLAN-MEYER CURVES




## KAPLAN-MEYER CURVES CONT.




## LIMITATIONS

- **TriNetX platform and retrospective design constraints:** This observational analysis relies on administrative ICD-10/CPT coding, which is susceptible to coding variability and lacks granular clinical detail. Despite propensity-score matching on 33 covariates, residual confounding from unmeasured variables including surgeon experience, institutional volume, and patient-specific anatomic factors cannot be excluded.
- **Substantial loss to follow-up:** At 5 years, only **27% of the robotic cohort and 30% of the non-robotic cohort** remained in follow-up. Patients who transfer care outside participating organizations are effectively lost, and differential attrition may introduce survivorship bias affecting long-term outcome estimates.
- **Generalizability:** Robotic cases are concentrated at higher-volume specialized centers, and the TriNetX network is predominantly US-based, which may limit applicability to broader practice settings and global populations.

## CONCLUSION

- In this propensity-score matched multicenter retrospective analysis, robotic mitral valve repair was associated with significantly lower rates of all-cause mortality (2.61% vs 5.36%), new-onset atrial fibrillation (12.22% vs 18.43%), MACEs (15.37% vs 20.06%), and mitral valve reoperation (1.71% vs 2.90%) at 5 years compared to non-robotic repair.
- These findings extend beyond prior national database studies — which were limited to perioperative outcomes, Medicare-age populations, or single-center experiences — by providing multicenter long-term data across the full adult age spectrum.
- However, these results should be interpreted with caution given the retrospective observational design, reliance on administrative coding, substantial patient attrition at 5 years (73% robotic, 70% non-robotic), and the potential for residual confounding from unmeasured variables such as surgeon experience, institutional volume, and valve pathology.
- **Prospective multicenter studies and registry-based analyses with more complete long-term follow-up, echocardiographic endpoints, and granular procedural data are needed to validate these findings and better define the patient populations most likely to benefit from robotic mitral valve repair.**

## REFERENCES

1. Mori M, et al. Robotic Mitral Valve Repair for Degenerative Mitral Regurgitation. Ann Thorac Surg. 2024;117:96–104.
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3. Arghami A, et al. Robotic MVR: A Decade of Experience With Echocardiographic Follow-Up. Ann Thorac Surg. 2022;114:1587–95.