

Original Article**Cardiac Function Outcomes Following Mitral Valve Replacement: A Comparative Analysis of Different Surgical Techniques Based on Our Experiences****Praman Sharma^{*1}, Lokesh Yadav¹, Dipak Kumar Yadav², Subhadra Agrawal³, Amritraj Pokhrel⁴**¹Department of Cardiothoracic and vascular Surgery, ²Department of General Surgery, ³Department of Obstetrics and Gynecology, Nobel Medical College Teaching Hospital, Biratnagar, Nepal, ⁴Clinical Trail Unit, Oxford University Clinical Research Unit Nepal, Lalitpur, Nepal.Article Received: 10th May, 2025; Accepted: 27th July, 2025; Published: 31st July, 2025**DOI: <https://doi.org/10.3126/jonmc.v14i1.83327>****Abstract****Background**

Mitral valve replacement is an essential treatment for mitral valve disease. Preserving both anterior mitral leaflet and posterior mitral leaflet during mitral valve replacement can yield good results in terms of left ventricular function. The study aims to examine whether retaining both leaflets is more advantageous compared to preserving none or only the posterior leaflet, particularly concerning left ventricular function.

Materials and Methods

This retrospective study includes 77 cases of mitral valve replacement performed over three years in the Nobel Medical College and Teaching Hospital. Demographics, co-morbidities, preoperative, perioperative and postoperative outcome in terms of left ventricle ejection fraction were noted in pre-structured questionnaires. The ethical clearance was taken from the Institutional Review Committee, Nobel Medical College and Teaching Hospital.


Results

The study categorized patients into three groups based on their surgical techniques: Posterior mitral leaflet preservation (group I), both leaflet excision (group II), and both leaflet preservation (group III). The mean age of the patients was 43.56 years, with 62.3% being female and 55.8% having thyroid disorder. Atrial fibrillation being most common arrhythmia involving 66.67%. Marked difference in preoperative and postoperative ejection fraction, group I 48.9 ± 7 to 51.9 ± 5.7 ($Z = -3.405$, $p = 0.001$), group II 53.9 ± 6 to 39.2 ± 6.6 ($Z = -3.405$, $p = 0.001$) and group III 47 ± 6.9 to 47.1 ± 9.5 ; $t(16) = 0.26$, $p = 0.798$ respectively. There was significant clinical improvement in New York Heart Association functional class.

Conclusion

This study shows that patients with leaflet preservation technique had good results in terms of improvement in New York Heart Association class, left ventricular ejection fraction and reduction in left ventricle dimensions.

Keywords: Mitral valve, Ejection fraction, Operative procedure, Heart valve

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Citation

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Introduction

Mitral Valve Replacement (MVR) is an important treatment for rheumatic mitral valve disease, has received widespread promotion and rapid development around the world with different surgical approaches. Lillehei et al. discovered in 1964 that preserving a portion of the mitral valve reduced mortality and complications while improving heart function [1,2]. Mitral valve replacement with posterior leaflet preservation was demonstrated to be helpful for postoperative left ventricular (LV) function in individuals with mitral regurgitation [3]. Surgeons often preserve most of the leaflets, including anterior mitral leaflet (AML) and posterior mitral leaflet (PML), or at least PML, depending on the mitral valve pathology and prosthetic valve size. Both AML and PML, along with adjacent chordae and papillary muscles maintain ventricular function [4].

Various surgical techniques exist for leaflet preservation worldwide, but factors like valve pathological changes, technical complexity, extended surgery, and potential prosthesis interference can hinder complete preservation, leading many surgeons to preserve only the posterior leaflet [5]. Both AML and PML along with their adjacent chordae and papillary muscles, play an equal role in maintaining ventricular function. Bileaflet-preserving MVR results in good outcomes, prompting surgeons to modify techniques to prevent tissue interference, implant appropriate valve sizes, and prevent LVOT occlusion [6-8].

The primary objective of this study was to examine whether retaining both leaflets is more advantageous compared to preserving only the posterior leaflet, particularly concerning LVEF.

Materials and Methods

Hospital based retrospective cohort study conducted at Noble Medical College and Teaching Hospital, Biratnagar, Morang. A total 77 case were observed between February, 2021 to January, 2024. The ethical approval for implementation of study was taken from Institutional Review Committee (IRC) of Nobel Medical College and Teaching Hospital. (IRC-NMCTH-122/2024). All the patients involved in the study were informed during the follow up period and written consent was taken during the follow up visit.

The data were collected in the pre-structured questionnaire from the discharge summary and case record file of the patients who were oper-

ated in the Cardio thoracic and Vascular surgery (CTVS) department. The patients meeting the criteria of MVR based on history, physical examination, electrocardiogram, echocardiography, and coronary angiography were included. The data included gender, age, cardiac disease, comorbidities, technique of surgery, cardiopulmonary bypass (CPB) details, perioperative and postoperative complications, duration of hospital stay, and mortality. Cases were followed up for 3 months post-operatively by telephone or outpatient visit. Convenient Sampling was done among the participants fulfilling the criteria.

The data were entered in Epi-data (version 3.0) and exported to IBM SPSS (version 20) for analysis. Pretesting of the tool was done among 10% of homogeneous participants. The outcome was defined as change in LVEF, LV dimensions, NYHA class, perioperative complications, hospital stay, survival, and mortality. Mortality was classified as in and post-hospital mortality. Post-hospital mortality was further classified as mortality due to cardiac versus non-cardiac events.

Results

The total no of participants enrolled in our study was 77. The data analysis involved categorizing patients into three groups according to the employed surgical techniques. Group I included patients undergoing PML preservation, Group II consisted of patients with both leaflet excision, and Group III comprised patients with both leaflet preservations.

The mean age of the patient was 43.56 years with female being major candidate 48 (62.3%). Among the comorbidities, thyroid disorder was noticed in 43(55.8%), followed by Peripheral Vascular Disease (PVD) 6(7.8%) and Cerebral Vascular Accident (CVA) 4(5.2%). Atrial fibrillation (AF) being commonest form of arrhythmia noticed among 52 (66.67%) patients. Dyspnea of NYHA class III or more was observed in 61 (78.2%) preoperatively.

Table 1: Clinical characteristics of patients among different groups

Variables	Total (n=77)	Group I (n=54)	Group II (n=6)	Group III (n=17)
Mean age (years)	43.6±11.9	43.2±12.5	39.2±8.7	46.2±10.9
Gender				
Male, n (%)	29 (37.7)	14 (25.9)	4 (66.7)	11(64.7)
Female, n (%)	48(62.3)	50 (74.1)	2 (33.3)	6(35.3)
Risk factors				
Thyroid, n (%)	43(55.8)	13(24.1)	29(33.3)	1(5.9)
Hxo PVD	6(7.8)	4(7.4)	0(0)	2(11.8)
Hxo-CVA	4(5.2)	4(7.4)	0(0)	0(0)
Arterial Fibrillation, n (%)	52 (66.67%)	36 (66.66%)	2 (33.33%)	14 (82.35%)



Group I: PML preservation; Group II: Both leaflet excision;
Group III: Both leaflet preservation
Hx0: History, PVD: Peripheral Vascular Disease, CVA:
Cerebrovascular accident

Table 2: Preoperative and 90 days postoperative values of LVEF, LVIDD/LVIDS.

Classifications	LVEF (%)		LVIDD/LVIDS	
	Preop	Postop	Preop	Postop
Total				
Group I (n=54)	48.9 ± 7	51.9 ± 7	(55.5 ± 5.5)/ (40.1 ± 7.6)	(52.8 ± 4.9)/ (38.8 ± 7)
Group II (n=6)	53.9 ± 6.1	39.2 ± 6.6	(52.6 ± 2.7)/ (33.3 ± 6.7)	(50.8 ± 2.7)/ (35.8 ± 5.1)
Group III(n=17)	47.6 ± 6.9	47.1 ± 9.5	(60.2 ± 8.6)/ (42.1 ± 10.2)	(57.2 ± 8.3)/ (40.2 ± 9.4)

Group I: PML preservation; Group II: Both leaflet excision; Group III: Both leaflet preservation

LVEF- Left ventricular ejection fraction

LVIDD- Left ventricular internal diastolic diameter

LVIDS- Left ventricular internal diastolic diameter at systole

NYHA: New York Heart Association; SD: Standard deviation

Table 2 shows the preoperative and postoperative value of LVEF, LVIDD/LVIDS. There was significant reduction in LVEF (%) in group II postoperatively along with decline in LV dimension.

Table 3: Preoperative and 90 days postoperative NYHA functional class

NYH	NYHA Functional Class							
	Total		Group I (n=54)		Group II (n=6)		Group III(n=17)	
	Preop (n)	Post op(n)	Preo p (n)	Posto p(n)	Preo p(n)	Posto p(n)	Preo p(n)	Posto p(n)
I	-	62	-	45	-	2	-	15
II	16	15	10	9	2	4	4	2
III	59	-	43	-	4	-	12	-
IV	2	-	1	-	-	-	1	-

Group I: PML preservation; Group II: Both leaflet excision; Group III: Both leaflet preservation

NYHA: New York Heart Association; SD: Standard deviation

Table 3 shows the NYHA classification of three different group among preoperative and postoperative cases. Most of the case lies in NYHA III in preoperative cases while it was in NYHA I after operation.

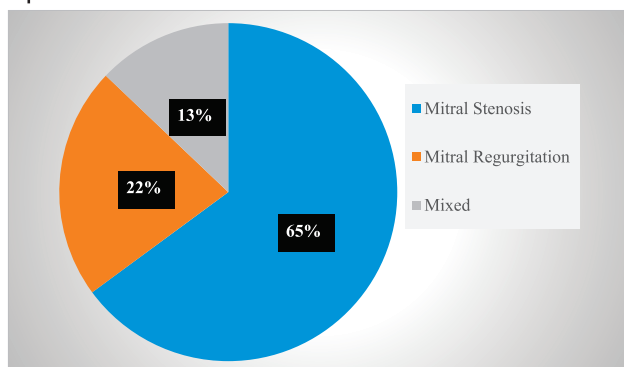


Figure 1: Mitral Valve Pathology

Sever Mitral Stenosis (MS) being the predominant pathology for the patients undergoing MVR encountering 50(64.9%), followed by Sever Mitral Regurgitation (MR) and Mixed type 17 (22.2%) and 10(12.9%) respectively shown in figure 1.

Table 4: Perioperative variables of patients divided into different groups

Variables	Total	Group I (n=54)	Group II (n=6)	Group III (n=17)
Mean CPB time (Minutes)	94.8±24.0	84.7±14.7	94.2±13.5	127.1±22.5
Mean ICU stays (days)	2.1±0.84	1.9±0.2	2.0±0	2.5±1.7
Mean hospital stays (days)	6.0±1.3	5.8±1.4	5.8±0.7	6.7±0.9

Group I: PML preservation; Group II: Both leaflet excision; Group III:

Both leaflet preservation

CPB: Cardiopulmonary Bypass

Table 4 shows the preoperative variables of different groups. The mean CPB time ranges from 84.7 minutes to 127.1 minutes with mean value of 94.8 minutes. Similarly, Mean ICU date was 2.1 days while total hospital days was 6 days.

Relationship between Pre and post-operative patients in different groups PML Preserved (Group I):

A Wilcoxon signed-rank test revealed a statistically significant difference between Preop-EF (48.9 ± 7) and Postop-EF (51.9 ± 5.7) ($Z = -3.405$, $p = 0.001$). A Wilcoxon signed-rank test also indicated a statistically significant difference between Preop-LVIDD (55.0 ± 5.6) and Postop-LVIDD (55.1 ± 6.2), ($Z = -4.018$, $p = <0.001$). Moreover, another Wilcoxon signed-rank test demonstrated a statistically significant difference between Preop-LVIDS (40.15 ± 7.6) and Postop-LVIDS (38.8 ± 7) ($Z = -2.88$, $p = 0.004$).

Both Excised Group (Group II):

A Wilcoxon signed-rank test showed a statistically significant difference between Preop- EF (53.9 ± 6) and Postop-EF (39.2 ± 6.6) ($Z = -3.405$, $p = 0.001$), ($Z = -2.032$, $p = 0.042$). A Wilcoxon signed-rank test also indicated a statistically significant difference between Preop-LVIDD (52.6 ± 2.7) and Postop-LVIDD (50.8 ± 2.7), ($Z = -1.604$, $p = 0.109$). Moreover, another Wilcoxon signed-rank test demonstrated a statistically significant difference between Preop-LVIDS (33.3 ± 6.7) and Postop-LVIDS (35.8 ± 5.1) ($Z = -0.405$, $p = 0.686$).



Both Preserved Group (Group III):

A dependent sample t-test showed a statistically significant difference in Preop-EF ($M=47.7$, $SD=6.9$) and Postop-EF ($M=47.1$, $SD=9.5$); $t(16) = 0.26$, $p=0.798$. Similarly, the dependent sample t-test demonstrated a significant difference in Preop-LVIDD ($M=60.2$, $SD=8.6$) and Postop-LVIDD ($M=56.6$, $SD=8.2$); $t(16) = 3.8$, $p=0.003$. Additionally, a dependent sample t-test indicated a significant difference in Preop-LVIDS ($M=42.1$, $SD=10.2$) and Postop-LVIDS ($M=40.2$, $SD=9.4$); $t(16) = 2.066$, $p=0.05$.

Follow-up

Above result was obtained after 90 days follow-up. Mortality was noticed in one patient in group II, where both leaflets were excised. Cause of mortality is likely deterioration in Left Ventricle Geometry leading to reduce EF which further enhance low cardiac output syndrome others have observable outcomes with good health status.

Discussion

In order to maintain appropriate LV function, the mitral valve—a complex anatomical structure made up of leaflets, annulus, chordae tendineae, papillary muscle, partial left atrial and ventricular walls, and neighboring aortic annulus is essential. Concentric contraction of the LV and annular displacement towards the apex during systole are facilitated by the coordinated movement of the sub valvular apparatus and mitral valve, which improves ejection performance[9].

Study conducted by Faruk Cing "oz et al. [6] shows a comprehensive overview of bileaflet preserving MVR and conventional MVR outcomes, specifically focusing on our Preserved Group (Group III) and Excised Group (Group II). Both studies reveal a significant increase in postoperative LVEF in the bileaflet preserving MVR group. Faruk Cing "oz et al. reports an increase at rest (from $52.74\% \pm 3.88\%$ to $62.86\% \pm 3.18\%$, $p = 0.0001$) and during exercise, aligning with our significant improvement in Preop-EF to Postop-EF (47.6 ± 6.9 to 47.1 ± 9.5) for the Preserved Group ($t(16) = -4.1$, $p=0.001$). Conversely, in the conventional MVR group, both studies observe a decrease in postoperative LVEF. Faruk Cing "oz et al. reports a decline at rest and during exercise, consistent with our Excised Group findings, which show a statistically significant difference in Preop-EF to Postop-EF ($Z = -2.032$, $p=0.042$). Noteworthy differences in specific measurements and statistical tests exist between the two studies, possibly attributed to variations in sample sizes,

patient characteristics, or methodologies. Despite these variances, the overall convergence of findings supports the evidence for the positive impact of bileaflet preserving MVR compared to conventional MVR.

In comparing our study with Yilong Guo et al. [1] research, both investigations explore the effects of different MVR techniques on left ventricle ejection fraction (LVEF). While Yilong Guo et al. categorizes patients into groups with distinct leaflet preservation techniques, our study focuses on the outcomes within Preserved (Group III) and Excised (Group II) groups. Both studies reveal positive trends in postoperative LVEF for preserved leaflet groups, with our findings aligning with Yilong Guo et al.'s Group A (total leaflet preservation). Notably, the studies collectively emphasize the importance of leaflet preservation in influencing postoperative cardiac function. However, variations in patient populations, methodologies, and specific techniques employed highlight the need for cautious interpretation of the results.

In our study, the preservation of the PML in Group I also resulted in a comparable improvement LVEF postoperatively. This is consistent with findings from Rafael García-Fuster et al. [5] study, where the preservation of the posterior leaflet also led to a significant difference in LVEF before and after surgery. The comparable positive outcomes in both studies underscore the potential benefits of preserving the posterior mitral leaflet in mitral valve surgeries. In one of the few comparisons of bileaflet preservation vs posterior-leaflet-only preservation, Yun and colleagues' study found no differences between the two methods in terms of LVEF and LV diameter[10]. Preservation of the sub valvular apparatus and valve-ventricular interaction was shown to be crucial in maintaining left ventricular regional wall motion and global function as compared to MVR with chordal excision[11].

Study done by Hatem et al created two groups of 24 adult patients. Group B consists of 12 patients with posterior leaflet preserved, while Group A consists of 12 patients with both leaflets preserved. The LVEF of the two groups differed significantly, according to the analysis. During MVR, maintaining both leaflets may have a greater postoperative LVEF than maintaining just the posterior leaflet [12].

A study from Texas by Ozdemir in Seventy patients having mitral valve replacement in our clinic were separated into two groups: MVR-B ($n=16$), in which both leaflets were preserved,



and MVR-P (n=54), in which only the posterior leaflet was preserved. The preoperative and postoperative clinical and echocardiographic results were analyzed retrospectively. The MVR-B group had no drop in left ventricular ejection fraction during the postoperative period, whereas the MVR-P group had a substantial decline ($P=0.003$). There were no differences between the two groups in the need for inotropic drugs or intra-aortic balloon pump support, cross-clamp time, length of intensive care unit or hospital stay, postoperative development of new atrial fibrillation, or mortality rates. The findings are consistent with our study too [7].

In this study, around 80 % of the cases lies in NYHA class III and IV during the preoperative visit while it is converted into NYHA Class I and II in postoperative stage. This shows that clinical improvement in the heart after the surgery. Similar study shows that clinical improvement in NYHA functional classification occurred in 80% to 91% of patients. More than four-fifth (82%) was in NYHA classes I or II at the time of follow-up, five patients (18%) were in class III, and there were no patients in class IV. This finding is similar to the finding of our study which shows that NYHA class improvement after the surgery [13].

There are some limitations of this study. This is a single center retrospective, non-randomized study in a limited number of patients and did not use multivariate analysis. Our findings need to be confirmed by other prospective, randomized, large-scale, long-term follow-up study using multivariate analysis.

Conclusion

Short term follow-up of cases with leaflet preservation technique whenever feasible, showed better outcome compared to complete excision. Patients who have rheumatic mitral valve stenosis also benefitted from this modified method. Compared to bi-leaflet excision to at least PML preservation alone or bi-leaflet preservation had good results in terms of improvement in NYHA class, LVEF and reduction in LV dimensions.

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Conflict of interest: None

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