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# REPAIR OF ISOLATED POSTERIOR MITRAL VALVE REGURGATION: RESECT OR NOT*

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## Abstract

Objective: Both resectional and non-resectional strategies used in the management of isolated posterior mitral leaflet repair have their own pros and cons, with no current consensus on their comparative superiority. In this study, operative and postoperative outcomes in patients undergoing isolated posterior leaflet repair with or without resection have been compared.

Materials & Method: A total of 129 patients undergoing isolated posterior leaflet repair due to mitral failure were included. Among these, several resection techniques including triangular, quadrangular, or sliding-leaflet annuloplasty were used in 63, while non-resection techniques such as plication, chorda shortening, chorda transfer, or artificial chorda implantation were implemented in 66.

Results: Resection group had longer cross-clamp and cardiopulmonary bypass time as compared to the non-resection group. The two groups were similar in terms of intra-operative IABP or inotropic support as well as early and late mortality and re-operation rates. At 12 months postoperatively, there were no significant differences in echocardiographic parameters.

Conclusion: Resectional and chordal replacement techniques are associated with comparable success rates. While resectional methods offer the advantage of providing curative treatment through removal of pathological tissue, chordal replacement techniques are associated with a predictable success rate in the context of a practical method that can be accomplished rapidly.

**Keywords:** mitral valve repair, chordal replacement, quadrangular resection, mitral valvuloplasty

# İZOLE POSTERİOR MİTRAL KAPAK YETERSİZLİĞİNİN ONARIMI: REZEKSİYON YAPMAK YA DA YAPMAMAK


**ÖZET**

Amaç: Mitral yetmezlikte tamir yöntemleri seçili vakalarda artık tüm otoriteler tarafından kabul gören bir teknik olarak ortaya çıkmıştır. Mitral kapak onarımlarıyla ilgili literatürde birçok yayın olduğu halde izole leaflet onarımlarının sonuçlarına dair veriler sınırlıdır. Bu çalışmamızda izole posterior leaflet onarımı yapılan hastalarda rezeksiyon yöntemleri kullanılanlarla, rezeksiyon yöntemleri kullanılmayan hastaların operatif ve postoperatif sonuçlarının karşılaştırılması amaçlanmıştır.

Materyal-Metod: Mitral yetmezliği nedeniyle izole posterior leaflet onarımı yapılan 129 hasta çalışma kapsamına alınmıştır. Bu hastaların 66'sının operasyon sırasında posterior leafletine trianguler, quadranguler veya sliding leaflet anuloplasti gibi rezeksiyon içeren yöntemler uygulanmıştır. Hastaların 63'ünde ise rezeksiyon yapılmamış, plikasyon, korda kısaltma, korda transferi ve yapay korda implantasyonu gibi teknikler uygulanmıştır. Hastalar postoperatif 12. aylarında ekokardiyografik ve klinik değerlendirilmeye alınmıştır. Ekokardiyografide mitral yetmezlik derecesi, pulmoner arter basınçları, sol ventrikül end-sistolik ve end-diyastolik çapları ölçülmüştür. Hastaların operatif kayıtları hastane veri tabanından alınmıştır.

Bulgular: Hastaların preoperatif yaş, cinsiyet, komorbidite, ritm, end-sistolik ve enddiyastolik çapları benzerdi. Posterior leaflete rezeksiyon yapılan grubun ortalama ejeksiyon fraksiyonunun daha düşük ve ortalama mitral yetmezlik seviyesinin yapılmayan gruba kıyasla daha yüksek olduğu görüldü. Hastaların operatif verileri karşılaştırıldığında posterior leaflete rezeksiyon yapılan grupta kross klemp ve kardiyopulmoner bypass sürelerinin rezeksiyon yapılmayan gruba kıyasla daha yüksek olduğu görüldü. İntraoperatif IABP ve inotrop destek kullanımı açısından iki grup arasında bir fark bulunamadı. Hastaların postoperatif erken ve geç mortalite oranları istatiksel olarak benzerdi. Hastaların reoperasyon oranları yine benzer olarak bulundu.

Sonuç: Çalışmamızda rezeksiyon yöntemlerinin kross- klemp ve kardiyopulmoner bypass sürelerini artırdığı ortaya çıkmıştır. Bu hastaların rezeksiyon yapılmayan hastalara nazaran daha ağır hastalar olduğu düşünülürse uzun kross-klemp ve kardiyopulmoner bypass sürelerinin yıkıcı etkilerinden hastaları korumak gerekir. Bu bağlamda özellikle seçili vakalarda rezeksiyon harici yöntemlerin tercihi hem hastayı, hem de cerrahı geri dönüşü zor, ağır sonuçlardan kurtarabilir. Bunun yanında rezeksiyon yöntemleri mortaliteyi artırmamaktadır.



**Anahtar Kelimeler:** mitral onarım, posterior, dejeneratif


## 1. INTRODUCTION

A decrease has been observed in the relative contribution of rheumatoid fever to the etiology of mitral failure paralleling the decline in the incidence of rheumatoid fever, while ischemic and degenerative conditions play a more significant etiologic role as a result of prolonged lifespan. The most common site of involvement in myxomatous and degenerative failure is represented by the posterior leaflet (1). A number of different methods have been described for posterior leaflet repair and in addition to ring placement, which is common to all procedures, chorda shortening, chorda transfer, artificial chorda replacement, or partial leaflet resections are also commonly utilized.

The long term success of quadrangular or triangular resection techniques, which remove the pathological leaflet tissue, has been clearly established (2). On the other hand, involvement

of two or more segments is associated with certain surgical challenges in the implementation of these approaches. In addition to resectional methods, additional procedures such as annular plication or sliding plasty may also be required. Chordal replacement techniques involving the use of expanded poltetrafluoroethylene (ePTF) sutures, originally introduced in 1980s, has gained more widespread acceptance with time and has become viable alternatives to resectional methods due to certain advantages such as being practical and predictable (3). Despite descriptions on the pros and cons of each of these two approaches, there is conflicting evidence on the respective superiority of these approaches.

In contrast with the multitude of studies reporting the outcome of mitral valve repair, literature on isolated posterior leaflet repair is relatively scarce. In this study, operative and postoperative data among two groups of patients undergoing posterior leaflet repair with or without resection.

## METHODS

A total of 129 patients undergoing posterior leaflet reconstruction due to mitral failure between 2007 and 2012 were included in this study. The procedures in these patients involved non-resectional and resectional approaches in 66 and 63 subjects, respectively. Resection procedures involved triangular resection, quadrangular resection, leaflet plication, sliding plasty, or chorda resection, while chorda transfer or artificial chorda replacement were used in the non-resectional group. All procedures were performed by the same surgeon. Patients' medical records were retrieved from the hospital database system to assess and record preoperative demographic, clinical, and operative data. Preoperative grading of the mitral failure and segment analysis were performed with transthoracic or transesophageal echocardiography (ECHO)(Vivid 7 Dimension, GE Medical Systems, Horten, Norway).An outpatient follow-up examination was scheduled at 12 months postoperatively for each patient to perform postoperative assessments and measurements. During the outpatient follow-up examination, history taking and physical examination were performed by the same physician, and a transthoracic ECHO was performed by a cardiologist.

### *Echocardiographic Parameters*

The same ECHO device was used in all patients to measure the left ventricular diastolic diameter (LVDD), left ventricular systolic diameter (LVSD), systolic pulmonary arterial pressure (SPAP), ejection fraction (EF), and the grade of the mitral failure.

Grading of the mitral failure was based on the regurgitating jet area and the width of vena contracta. In accordance with the institutional protocols, mitral failure was graded on a 4-point scale, where a grade of 1, 1 to 2, 2 to 3, and ≥ 3 were considered to denote the presence of minimal, mild, moderate, or severe mitral failure.

***Surgical Procedure***

Following general anesthesia, cardio pulmonary bypass was initiated with arterial cannulation through the ascending aorta and venous cannulation through the aorto-bicaval route and cooling to 32 C was performed. After antegrade and retrograde cardioplegia following cross-clamping, mitral valve was accessed through a left atriotomy using the Sondengaard plane. The mitral valve was inspected using hooks and an effort was made to identify the reactive endocardial thickening zone resulting from the jet of flow into the left atrium from the regurgitating volume. The repair technique was decided intra-operatively. All patients were operated by the same surgeon using one of the techniques that did or did not involve resection. The 63 patients in the resection group underwent triangular resection, quadrangular resection, or sliding plasty, while 66 patients in the other group received leaflet plication, chorda shortening, chorda transfer, or artificial chorda implantation. Anterior leaflet length was measured for choosing the appropriately sized ring, and ring annuloplasty was performed. Following the repair, the valvular coaptation was checked using physiological saline. After achievement of satisfactory repair, the left atrium was closed using continuous polypropylene sutures and the cross-clamp was removed following air removal. After completion of the cardiopulmonary bypass, incisions were closed in the standard manner.

***Statistical Methods***

SPSS v 18.0 software package (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as percent frequency. The statistical differences between the resection and no-resection groups were compared with t-test for continuous variables and with chi-square

test for categorical data. Survival analysis was performed using Kaplan-Meier estimates. A p value of less than 0.05 was considered statistically significant.

## 3. RESULTS

The two patient groups were comparable with respect to pre-operative demographic such as age, gender, cardiac rhythm status, diabetes, chronic renal failure, and chronic obstructive pulmonary disease (Table 1).

Also, pre-operative echocardiographic parameters other than EF and grade of the mitral failure were similar across the two groups. Patients who underwent posterior leaflet resection had lower pre-operative ejection fraction than those in the non-resection group. Again, patients in the resection group had significantly higher grade of mitral failure than in the non-resected group (Table 1).

Assessment of the operative data showed longer cross-clamp and cardiopulmonary bypass duration in the resection group than in the non-resection group ($p = 0.02$ and 0.009, respectively). The two groups did not differ significantly in the use of intraoperative intra-aortic balloon pumping or need for inotropic support ($p=0.19$ and 0.43, respectively).

At postoperative month 12, the two groups did not differ significantly in terms of echocardiographic measurements including end-systolic diameter, end-diastolic diameter, ejection fraction, mean grade of mitral failure, and pulmonary arterial pressure (Table 2).

Comparison of pre-operative and post-operative echocardiographic parameters did not reveal significant differences (Table 3).

One patient in each group died due to low cardiac output syndrome (one at postoperative day one, and other at day 2) ($p=0.97$). In the overall patient group, in-hospital mortality rate was 1.5%. In the resection group, there were 5 late mortalities, 3 due to heart failure, and 2 due to infection. In the non-resection group, there were 3 late deaths, all due to infection. Survival analyses did not show significant differences between the two groups in terms of late mortality rates ($p=0.97$).

Two patients underwent mitral valve replacement due to symptomatic mitral failure, and one patient had repeated repair procedure in the late post-operative period.

## 4. DISCUSSION

Our results suggest similar success rates for procedures with or without resection in the repair of isolated posterior leaflet prolapse. The two groups of patients with similar demographic and echocardiographic characteristics were also comparable in terms of both operative parameters and follow-up echocardiographic results.

Surgical mitral valve repair procedures due to posterior leaflet prolapse offer low operative risk, excellent long-term survival, and durability (4). Best results are achieved when the repair is performed prior to the onset of symptoms and development of structural and functional changes in the heart (5). In addition to ring annuloplasty, additional interventions on the leaflet may include resection on the leaflet tissue, plications and/or chordal procedures aiming a good coaptation. Although techniques involving tissue resection are frequently curative owing to the removal of the pathological tissues, they present certain challenges such as the requirement for surgical expertise as well as being anatomically complicated. Although chordal replacement techniques leave some residual pathological tissue, they also provide better mobility for the posterior leaflet, with a simple technique resulting in similarly uniform outcomes as suggested by many previous reports.

After the establishment of repair procedures as an effective surgical modality for the treatment of degenerative mitral valve prolapse, quadrangular resection has become the gold standard approach for the posterior leaflet repair (4).Chordal replacement, which was originally introduced for anterior leaflet repair only, was subsequently utilized in posterior leaflet repair with reasonably favorable outcomes. Similarly, leaflet plication techniques combined with chordal replacement allows removal of the redundant tissue without resection, contributing to coaptation. However, no definitive data exists on the comparative superiority of these techniques, with discrepant results in the published literature. The reported 5-, 10-, and 15-year reoperation-free rates in patients undergoing resection are 94.3-98.7% (6, 7), 81.7-94.7% (6, 8, 9, 10), and 92.2% (11), respectively, while in studies involving patients who underwent non-resectional procedures the corresponding figures at 5 and 10 years are 93.9-98%(7,12) and 93-98.5%(2,12,13,14), while the 20-year reoperation-free rates are %88-96.9% (2,14). Although the non-resection groups in those studies had somewhat shorter follow-up and smaller sample size, generally these techniques have been concluded to offer similar outcomes.

However, 10-year survival rates reported for resection and chordal replacement techniques are 88-89.3% (2, 8) and 79-93.5% (2, 12, 13, 14), respectively, largely consistent with our observations.

While resection techniques usually represent the choice of surgery in cases with severe prolapse or excessive pathological redundant tissue, chordal replacement may be used as a quick and simple procedure with more predictable results in other patients. Although Ibrahim et al. (15) reported a higher risk:benefit ratio for chordal replacement (15) than for resectional techniques, these authors also pointed out to the fact that this difference indicates the need for a meticulous technique in the adjustment of chordal length. Rankin et al. (16) found higher mitral repair rate with the use of non-resectional approaches (16). In a patient series involving 397 subjects with posterior leaflet prolapse, Lange compared neochorda repair with quadrangular resection and observed a reoperation-free rate of 96% and 99% for these two approaches, respectively. Also, patients in the neochorda group had a longer coaptation line, a more physiological leaflet repair, and feasibility to use rings of larger dimensions (17). Similarly Kudo (18) and Seeburger (17) underscored the advantages of chordal replacement in their studies comparing the two techniques.

Resectional techniques inherently require a longer duration of surgery with prolonged cross-clamp and cardiopulmonary bypass, placing extra burden on the patient in addition to that originating from the disease itself. In our study, patients who underwent resection in the posterior leaflet had longer cross-clamp and cardiopulmonary bypass time as compared to those who did not. These data suggest that, in selected cases with more severe mitral failure and lower ejection fraction, non-resectional methods may be preferred to avoid prolonged cross-clamping and cardiopulmonary bypass.

Despite the absence of a difference between the two groups in our patient group with respect to EF at 12 months postoperatively, some authors such as Imasaka et al. (19) found better LV function with chordal replacement than resection, explaining this advantage on the basis of less leaflet morbidity, larger coaptation surface area, and preservation of the ventriculo-annular continuity. Therefore, in patients with lower LVEF, it may be more plausible to opt for chordal replacement if possible.

In this study conducted to assess the efficacy of different repair techniques for posterior leaflet prolapse, several limitations such as small sample size, absence of randomization,

retrospective nature, and relatively shorter follow-up should be mentioned. Due to the high incidence of rheumatoid valvular disease in our country, number of patients undergoing surgery for posterior leaflet prolapse is smaller compared to other types of mitral valve surgery, inevitably leading to smaller sample size in such studies. Therefore, we believe that our observations may carry some significance as a contribution to national database. Randomization could not be performed, unfortunately, due to its retrospective nature. Despite a relatively larger sample size and first reporting on this patient population in our country, we believe that further prospective, randomized studies with larger sample size and longer follow-up are warranted.

## 6. **CONCLUSION**

Resectional and chordal replacement techniques may yield similar success rates in the surgical treatment of patients with posterior leaflet prolapse of the mitral valve. While resectional strategies offer the advantage of being curative due to the removal of the pathological tissue, chordal replacement strategies are associated with a number of advantages such as predictable success rate, simplicity, practicality, and shorter duration of surgery. Potential contribution to LV functions, shorter duration of surgery, and the absence for requirement for advanced surgical skills now bring the "respect to leaflet" approaches, i.e. the chordal replacement techniques, into prominence.

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## Tables

**Table 1.**Comparison of the pre-operative data in patient groups

| **Demographic characteristics** | **Resection group (n=63)** | **Non-resected group (n=66)** | **P value** |
|---|---|---|---|
| **Age** | 56.11±14.4 | 53.67±17.1 | 0.379 |
| **Gender** | | | |
| Female | 21 (33.3%) | 29 (43.9%) | 0.218 |
| Male | 42 (66.7%) | 37 (56.1%) | |
| **Rhythm** | | | |
| NSR | 51 (81.0%) | 56 (84.8%) | 0.558 |
| AF | 12 (19.0%) | 10 (15.2%) | |
| **Chronic renal failure** | 2 (3.2%) | 5 (7.6%) | 0.272 |
| **Chronic obstructive disease** | 21 (33.3%) | 18 (72.7%) | 0.455 |
| **Diabetes mellitus** | 6 (9.5%) | 11 (16.7%) | 0.232 |
| **Hypertension** | 19 (30.2%) | 26 (39.4%) | 0.273 |
| **Grade of the mitral failure** | 3.00±0.440 | 2.69±0.617 | **0.001** |
| **Ejection fraction** | 49.21±10.74 | 53.92±11.87 | **0.02** |
| **End-diastolicdiameter** | 55.94±7.03 | 54.70±6.29 | 0.293 |
| **End-systolicdiameter** | 40.84±6.63 | 40.08±6.64 | 0.516 |
| **Pulmonary artery pressure** | 44.36±13.30 | 44.12±14.69 | 0.92 |

**Table2**.Comparison of echocardiographic parameters at postoperative month 12

| **Postoperativedata** | **Resection group (n=63)** | **Non-resected group (n=66)** | **P value** |
|---|---|---|---|
| **Grade of mitral failure** | 0.94± 0.68 | 0.89± 0.32 | 0.547 |
| **Ejection fraction** | 53.21± 10.63 | 51.34± 9.56 | 0.327 |
| **End-diastolicdiameter** | 51.17± 4.56 | 51.13± 5.85 | 0.971 |
| **End-systolicdiameter** | 37.17± 5.64 | 36.97± 5.51 | 0.848 |
| **Pulmonary artery pressure** | 32.85± 7.27 | 32.41± 5.73 | 0.717 |

**Table 3.**Comparison of pre- and post-operative echocardiographic data

| | **Preoperative values** | **Postoperative values** | **P value** |
|---|---|---|---|
| **End-diastolicdiameter** | | | |
| No resection | 54.70±6.29 | 51.13±5.85 | 0.326 |
| Resection | 55.94±7.03 | 51.17±4.56 | |
| **End-systolicdiameter** | | | |
| No resection | 40.08±6.64 | 36.97±5.51 | 0.713 |
| Resection | 40.84±6.63 | 37.17±5.64 | |
| **Ejection fraction** | | | |
| No resection | 53.92±11.87 | 51.34±9.56 | 0.190 |
| Resection | 49.21±10.74 | 53.21±10.63 | |
| **Mitral failure** | | | |
| No resection | 2.69±0.617 | 0.89±0.32 | 0.220 |
| Resection | 3.00±0.440 | 0.94±0.68 | |
| **Pulmonary artery pressure** | | | |
| No resection | 44.12±14.69 | 32.41±5.73 | 0.816 |
| Resection | 44.36±13.30 | 32.85±7.27 | |