Valve Replacement with Chordal Preservation and Valvuloplasty for Chronic Mitral Insufficiency

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Objective - *To compare, from the clinical and laboratory points of view, 3 groups of patients undergoing surgical treatment for isolated chronic mitral insufficiency. One group underwent valvuloplasty, and the other 2 groups underwent mitral valve replacement with different techniques for chordal preservation.*

Methods - *Twenty-eight patients with a mean age of 54.1 years, no coronary or multivalvular disease, and no reoperation, underwent surgery as follows: 9 underwent valvuloplasty; 10 underwent mitral valve replacement with chordal preservation in both leaflets; and 9 underwent mitral valve replacement with chordal preservation only in the posterior leaflet. Clinical, Doppler echocardiographic, and radionuclide ventriculographic assessments were performed until the 6th month of follow-up.*

Results - *At the end, 88.8% of the patients were in functional class I. One died due to intracranial hemorrhage during anticoagulant treatment. The left ventricular diastolic diameter (P<0.0001) and end-diastolic volume (P<0.0001) decreased in the 3 groups. Only the patients undergoing valvuloplasty had a decrease in systolic diameter (P=0.0003) and in end-systolic volume (P=0.0040), with no change in the ejection fraction (P=0.5586). The patients undergoing mitral valve replacement had a similar drop in ejection fraction (P=0.0001 and P=0.0296).*

Conclusion - *The 3 surgical techniques used provided clinical improvement. Patients undergoing valvuloplasty had better preservation of ventricular function. No significant difference was observed in cardiac performance between the 2 groups undergoing mitral valve replacement with chordal preservation within a 6-month follow-up.*

Key words: mitral valve insufficiency, surgery, valvular prosthesis implantation, methods, chordae tendineae

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After the report of favorable results with mitral valvuloplasty for patients with chronic mitral insufficiency, mitral valve replacement with preservation of the chordae tendineae was revised by David et al [1] and Hetzer et al [2] in 1983. These authors reported convincing clinical evidence favoring the maintenance of the annulopapillary continuity, which had already been demonstrated in the pioneering study by Lillehei et al [3] in 1964. The following years brought clinical and experimental evidence supporting this concept and spreading the recommendation not to excise all chordae tendineae in mitral valve replacement, which raised the following question: which type of chordal preservation should be used, of both leaflets or of only the posterior leaflet? Hannein et al [4] and Straub et al [5] reported no significant difference in ventricular performance between these 2 groups of patients. On the other hand, Hassouna and Elmahalawi [6] and Yun et al [7] reported better left ventricular systolic performance and a lower mortality rate in the group undergoing chordal preservation of both leaflets. As a result, many surgeons continue to express their preoccupations with the demand for higher technical complexity, longer surgical time, the potential interference with the mobility of a leaflet or of a prosthetic occluding disk, the eventual need for underestimating the diameter of a prosthesis for the mitral ring, and the possibility of creating an obstruction in the left ventricular outflow tract. The lack of consensus led us to this line of research.

Methods

This study consecutively analyzed 28 symptomatic patients who underwent surgery for isolated chronic mitral regurgitation at the Instituto do Coração of the Hospital das Clínicas of the FMUSP from April 2000 to November 2002. Their ages ranged from 17 to 78 years (mean, 54.1±15.8 years; median, 55 years), and their weight ranged from 43 to 92 kg (mean, 61±13 kg; median, 60 kg). Nineteen (67.9%) were men and 9 (32.1%) were women. All patients consented to the surgery and to take part in the study.

The inclusion criterion was the presence of significant chronic mitral insufficiency. The exclusion criteria were as

follows: patients with significant coronary artery disease (any coronary artery with stenosis > 50%), associated important aortic or tricuspid valve disease, reoperations, and significant mitral stenosis. The surgical indication was decided by the clinical team based on clinical, Doppler echocardiographic, hemodynamic, and angiographic criteria. Significant mitral insufficiency was shown in all patients on Doppler echocardiography and on left ventriculography, when applicable.

As personal antecedents, we found 5 (17.9%) patients with a history of rheumatic fever, 3 (10.7%) with arterial hypertension, 2 (7.1%) with diabetes mellitus, 1 (3.6%) with a history of stroke with no motor sequelae, 1 (3.6%) with a history of infective endocarditis, and 1 (3.6%) with epilepsy.

Physical activity was classified according to the 4 functional classes (FC) of the New York Heart Association. Only 1 (3.6%) female patient was in FC IV (case 26); the remaining 27 (96.4%) were in FC III. The postoperative recordings were obtained at 3 and 6 months of follow-up. The cardiac rhythm was analyzed on ordinary 12-lead electrocardiography. Five (17.9%) patients had atrial fibrillation and 23 (82.1%) had sinus rhythm. Follow-up recordings were obtained at 3 and 6 months.

Cardiac catheterization was performed only in the preoperative phase in all patients aged ≥ 40 years (23 patients, 82.1%). Three (10.7%) patients aged < 40 years had already undergone the procedure by the time of inclusion in the study, adding up to 26 patients studied on cardiac catheterization. Right and left chamber pressure recordings were used to compare the groups operated on only in this phase.

Doppler echocardiography was performed with the Philips – ATL device, HDI 3000 model, and the Philips – HP 1500 device (Bothell, WA, USA) with 2.0- and 3.0-megahertz transducers. The images were obtained in parasternal, apical, and subcostal views in several planes. The following measurements were taken: left ventricular systolic diameter (LVSD); left ventricular diastolic diameter (LVDD); left ventricular ejection fraction (EF); left ventricular end-diastolic volume (EDV); and left ventricular end-systolic volume (ESV). Detection and quantification of mitral reflux were performed with color flow mapping obtained on the left parasternal and 2- and 4-chamber apical views, and with pulsed-wave Doppler.

All patients underwent radionuclide ventriculography (gated) at rest up to 1 month before surgery. The images were obtained in an ADAC-TranScan gamma-chamber coupled to a Unix (SUN) computer model Pegasys. The following parameters were analyzed: end-diastolic volume (EDV); end-systolic volume (ESV); right ventricular ejection fraction (RVEF); and left ventricular ejection fraction (LVEF) calculated according to the equation: EF = (CD – CS) / CD, where CD and CS refer to the radioactive countings corresponding to maximum diastole and systole.

After induction of anesthesia, a thermodilution balloon catheter was introduced through puncture of the right internal jugular vein and was advanced as far as its distal impaction in the pulmonary tree. The system was connected to a computer for recording and calculating the following hemodynamic variables: cardiac index (CI); left ventricular systolic work index (LVSWI); pulmonary vascular resistance index (PVRI); and systemic vascular resistance index (SVRI). The measurements were taken 4 times as follows: IO1 – before median sternotomy; IO2 – prior to heparin administration; IO3 – after protamine sulfate administration; and IO4 – after suture of the sternum.

A transesophageal transducer was positioned for intraoperative qualitative Doppler echocardiographic assessment twice, as follows: during chest opening and after discontinuation of extracorporeal circulation.

All surgeries were performed through a median sternotomy. Extracorporeal circulation was established through cannulation of the ascending aorta and both venae cava separately, and disposable membrane oxygenators were used. The left atrium was longitudinally opened. The site of greatest reflux was checked with injection of saline solution inside the left ventricle. The intraoperative decision regarding the choice of valvuloplasty or valvular replacement was made up based on the anatomical status of the mitral valve, which, whenever possible, was repaired. However, when the anatomic conditions indicated the need for prosthetic implantation, a list with previous randomization was consulted, and the patient underwent one or the other techniques of chordal preservation (preservation of both leaflets or of only the posterior leaflet). Based on this, the 3 following groups of patients were formed: 1) the valvuloplasty group, comprising the patients undergoing valvuloplasty; 2) the group of both leaflets, comprising the patients undergoing mitral valve replacement according to the technique of Miki et al [8], which preserves the chordae tendineae of both leaflets; and 3) the posterior leaflet group, comprising the patients undergoing mitral valve replacement with chordal preservation of only the posterior leaflet. The 3 groups were compared in regard to data obtained on cardiac catheterization and Doppler echocardiography in the preoperative period (tab. I and II). Fragments of the leaflets could be removed for anatomicopathological examination in 27 patients.

Functional class recordings and analysis of the cardiac rhythm were obtained at 3 and 6 months of follow-up, as were transthoracic Doppler echocardiographies, also performed prior to hospital discharge. A second radionuclide ventriculography at rest was performed 6 months after surgery.

All continuous variables were reported as minimum, maximum, median, mean, and standard deviation values,

Table I - Preoperative cardiac catheterization data

	Groups						
	Both		Posterior		Valvuloplasty		P
	mean	sd	mean	sd	mean	sd	
RAP	10.22	3.96	6.88	3.56	7.33	2.87	0.1166
RVSP	58.11	24.00	42.88	26.81	60.78	26.65	0.3296
MPPT	35.56	14.73	25.25	17.14	35.00	12.94	0.1583*
PCP	21.67	6.38	16.50	7.45	20.89	6.88	0.2768
$LVPD_2$	17.00	8.05	13.00	6.39	16.44	5.08	0.4246

P = descriptive level of the analysis of variance; P* = descriptive level of the Kruskal-Wallis test; RAP = right atrium pressure (mmHg); RVSP = right ventricular systolic pressure (mmHg); MPPT = mean pressure of the pulmonary trunk (mmHg); PCP = pulmonary capillary pressure (mmHg); $LVPD_2$ = left ventricular end-diastolic pressure (mm Hg).

Table II - Preoperative transthoracic echocardiogram data

	Groups						
	Both		Posterior		Valvuloplasty		P
	mean	sd	mean	sd	mean	sd	
LVDD	71.10	14.65	66.44	6.95	64.22	4.55	0.3355
LVSD	44.10	10.33	45.22	8.42	43.78	6.16	0.9316
EDV	402.40	266.59	301.89	96.92	268.44	55.37	0.3228
ESV	99.40	77.46	99.78	63.19	88.44	35.25	0.9062
EF	0.75	0.05	0.67	0.14	0.67	0.11	0.1341

P = descriptive level of the analysis of variance; LVDD = left ventricular diastolic diameter (mm); LVSD = left ventricular systolic diameter (mm); EDV = end-diastolic volume of the LV (cm^3); ESV = end-systolic volume of the LV (cm^3); EF = LV ejection fraction.

and the categorical variables were reported as absolute and relative frequencies. The hypotheses of equality of the covariance matrices between the groups and the normal distribution of the data were assessed, and the values obtained were compared among the 3 groups of patients by using analysis of variance for data with normal distribution and the Kruskal-Wallis test [9] for data that did not satisfy the supposition of normality. The Doppler echocardiographic data relating to radionuclide ventriculography and the hemodynamic measurements were compared at several moments in each group, and among the groups, through analysis of variance for repeated measures [10]. Within this context, the 3 following hypotheses were tested: interaction, group effect, and effect of time. Qualitative variables were analyzed using the Fisher exact test [11]. A descriptive level (P) lower than 0.05 was considered statistically significant.

Results

Of the 28 patients operated on, 9 (32.1%) were in the valvuloplasty group as follows: 7 (25%) underwent quadrangular resection according to the double-Teflon technique® [12], and 2 (7.1%) underwent posterior annuloplasty with a bovine pericardial patch. Ten (35.7%) patients comprised the group of both leaflets, and 9 (32.1%) comprised the posterior leaflet group. Three (10.7%) patients underwent the following complementary procedures: 1 (3.6%) patient underwent De Vega tricuspid valve annuloplasty; 1 (3.6%) underwent commissurotomy and decalcification of the aortic valve; and another (3.6%) underwent cerclage of the aortic ring related to the noncoronary leaflet.

The intraoperative transesophageal Doppler echocardiographic evaluation prior to extracorporeal circulation revealed the following findings: rupture of the chordae of the posterior leaflet in 11 (39.3%) patients; lack of coaptation of the leaflets in 8 (28.5%) patients; rupture of the chordae of the anterior leaflet in 5 (17.9%) patients; prolapse of the posterior leaflet in 2 (7.1%) patients; prolapse of the anterior leaflet in 1 (3.6%) patient; and prolapse of both leaflets in 1 (3.6%) patient. No thrombus was detected inside the left atrium or left auricle. The result of valvuloplasty was considered good on transesophageal Doppler echocardiography after extracorporeal circulation in all cases. Neither regurgitation through the prosthesis nor obstruction in the left ventricular outflow tract was observed in any patient in the groups of both leaflets and of the posterior leaflet.

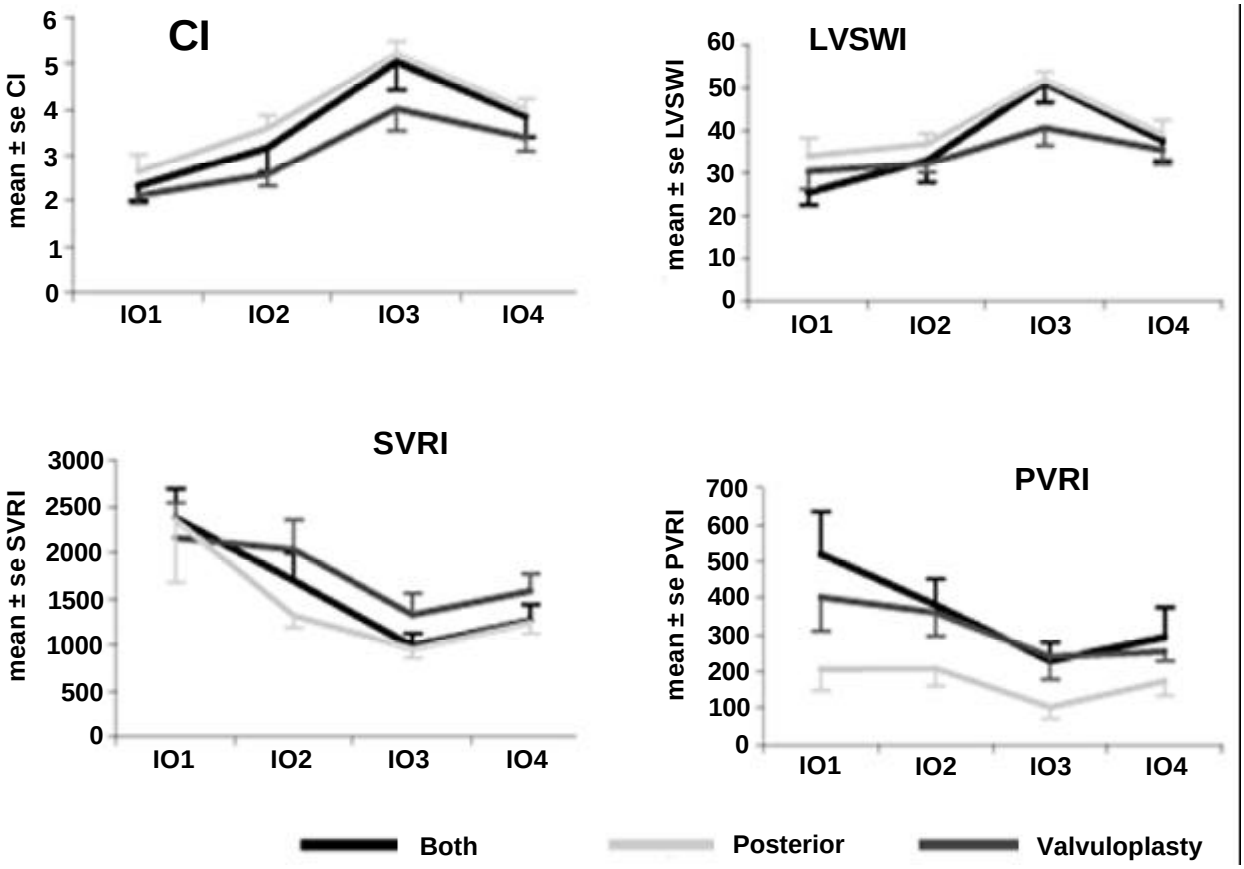
In regard to the hemodynamic variables, an increase in the CI ($P < 0.0001$) was observed, mainly after completion of the procedure, accompanied by an increase in the LVSWI ($P < 0.0001$) in the 3 groups. No significant difference was observed among the groups regarding the behavior of SVRI ($P = 0.0599$) and PVRI ($P = 0.0644$), which decreased after surgery (chart I).

No in-hospital mortality was observed. Seven (25%) patients had the following in-hospital complications: acute atrial fibrillation in 2 (7.1%) patients; pericardial effusion in 2 (7.1%); phrenic paresis in 1 (3.6%); transient total atrioventricular block in 1 (3.6%); and infective endocarditis in 1 (3.6%) (chart II). The 2 patients with acute atrial fibrillation were pharmacologically reverted, and none of them had had it before. The 2 patients with pericardial effusion underwent surgical drainage with no recurrence. The patient with total atrioventricular block was maintained with an external pacemaker until the fourth postoperative day, when sinus rhythm was spontaneously resumed. The patient with clinical findings of endocarditis in the prosthesis belonged to the group of the posterior leaflet and underwent replacement of the mitral bioprosthesis for another of the same type on the 30th postoperative day. After the second surgery, the evolution was satisfactory, and the patient was discharged on the 14th postoperative day. Two (7.1%) patients had complications 2 months after surgery. The complications were of the hemorrhagic type in both, enterorrhagia in one and fatal stroke in another (case 17). The latter patient belonged to the group of both leaflets and was discharged from the hospital with a prescription of oral anticoagulant (dicoumarin) in a total dose because he had chronic atrial fibrillation.

Table III shows comparative data of the 3 groups regarding the duration of extracorporeal circulation, duration of aortic cross-clamping, intensive care unit length of stay, mediastinal drainage volume, duration of hospitalization, and number of patients using vasoactive drugs for more than 24 hours. The patients undergoing valvuloplasty had a shorter time of extracorporeal circulation ($P = 0.0016$) and of aortic cross-clamping ($P < 0.0001$). No statistically significant difference was observed between the 2 groups undergoing mitral valve replacement with chordal preservation.

Three months after surgery, 23 (85.2%) of the 27 patients studied were in FC I; 3 (11.1%) in FC II; and only 1 (3.7%) in FC III. Six months after surgery, 24 (88.9%) patients were in FC I, and 3 (11.1%) were in FC II. The evolution of all patients according to functional class is shown in chart III. No significant difference in functional class distribution was observed in the groups studied 3 months ($P = 1.0000$) and 6 months ($P = 0.7508$) after surgery. When assessing cardiac rhythm, 4 of the 5 patients with atrial fibrillation in the preoperative period remained with arrhythmia 3 and 6 months after surgery, because they had chronic atrial fibrillation. No thromboembolism was observed up to the 6th month of follow-up.

In regard to the evolution of Doppler echocardiographic variables, the LVDD and EDV curves were similar in the



CI = cardiac index (L/min/m²); LVSWI = left ventricular systolic work index (g/L/m²); SVRI = systemic vascular resistance index (dyne/cm⁵/m²); PVRI = pulmonary vascular resistance index (dyne/cm⁵/m²)

Chart I - Evolutionary curves of CI, LVSWI, SVRI, and PVRI.

Complications	N	(%)	Cases
In-hospital			
Acute AF	2	7.1	13 e 27
Pericardial effusion	2	7.1	5 e 21
Phrenic paresis	1	3.6	9
Transient TAVB	1	3.6	12
Infective endocarditis	1	3.6	10
Total	7	25	
Late			
Enterorrhagia	1	3.6	9
Hemorrhagic stroke	1	3.6	17
Total	2	7.1	

Chart II - In-hospital and late complications.

Table III - Comparative data of the in-hospital period in each group

	Groups						
	Both		Posterior		Valvuloplasty		P
	mean	sd	mean	sd	mean	sd	
TECC	99.50	20.34	90.00	18.37	73.56	8.71	0.0016
TCCAo	79.00	16.01	72.11	16.34	47.33	7.52	<0.0001
TICU	2.40	1.07	2.11	0.33	2.44	1.01	0.8091*
TINT	13.30	6.99	13.56	4.75	11.89	2.20	0.5711
Drain	564.00	188.57	702.22	220.72	608.89	316.80	0.3586
VAD	3 patients		2 patients		1 patients		0.8452*

P = descriptive level of the analysis of variance; P* = descriptive level of the Kruskal-Wallis test; TECC = time of extracorporeal circulation (minutes); TCCAo = time of cross-clamping of the aorta (minutes); TICU = time of ICU (days); THOSP = time of hospitalization (days); drain = mediastinal drainage volume (milliliters); VAD = need for vasoactive drugs for more than 24 hours.

3 groups, with a significant decrease already in the in-hospital phase, and a progressive and lower intensity reduction up to the 6th month of follow-up. However, only the patients in the valvuloplasty group had a significant drop in LVSD and ESV (P = 0.0017 and P = 0.0101, respectively). The ejection fraction curves were different in the 3 groups studied: the patients in the group of both leaflets had a significant drop already in the in-hospital phase (P < 0.0001), with a tendency towards recovery in the following phases; the patients in the posterior leaflet group had the greatest drop at 3 months after surgery; and the patients in the valvuloplasty group had no significant difference at all phases analyzed (P = 0.5586). Chart IV shows the evolutionary curves of EDV, ESV, and EF in each group.

The radionuclide ventriculography also showed a decrease in the EDV in the 3 groups. However, only the patients

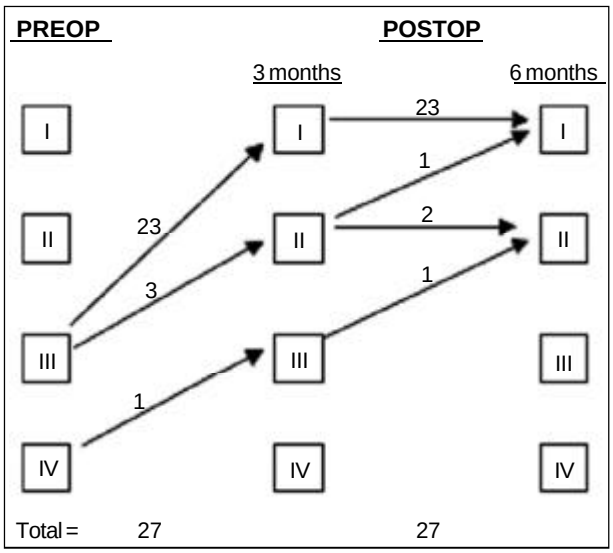


Chart III - Evolution of NYHA function class.

in the valvuloplasty group had a significant drop in ESV, reaching a 42% reduction at 6 months after surgery as compared with the preoperative value (P = 0.0012). Although a mild increase in absolute values occurred, no statistically significant changes were observed in RVEF (P = 0.0675). In regard to ejection fraction, that examination showed a drop in all groups (P < 0.0001), with no statistically significant difference among them (chart V).

Table IV shows the distribution of the anatomicopathological diagnosis in the 3 groups studied. No statistically significant difference was observed in the incidence of myxomatous degeneration, rheumatic disease, and endocarditis (P = 0.9416). In 1 patient, whose material was not collected for anatomicopathological study, the gross appearance was that of myxomatous degeneration.

Discussion

Mitral insufficiency is a valvular heart disease that causes complex hemodynamic changes. In chronic mitral insufficiency, the left ventricle initially dilates, and, subsequently, undergoes hypertrophy, recovering the relation between ventricular mass and end-diastolic volume. The velocity of the increase in the end-diastolic volume depends on the importance and nature of the regurgitation. The end-systolic volume is also increased, but has a considerable individual variation. The effect of regurgitation on hemodynamic balance depends on the intensity of regurgitation and left atrial compliance. Significant insufficiency, most of the time, is oligosymptomatic for a long period and may have a high incidence of ventricular dysfunction at the time of surgery, which may affect postoperative survival [13].

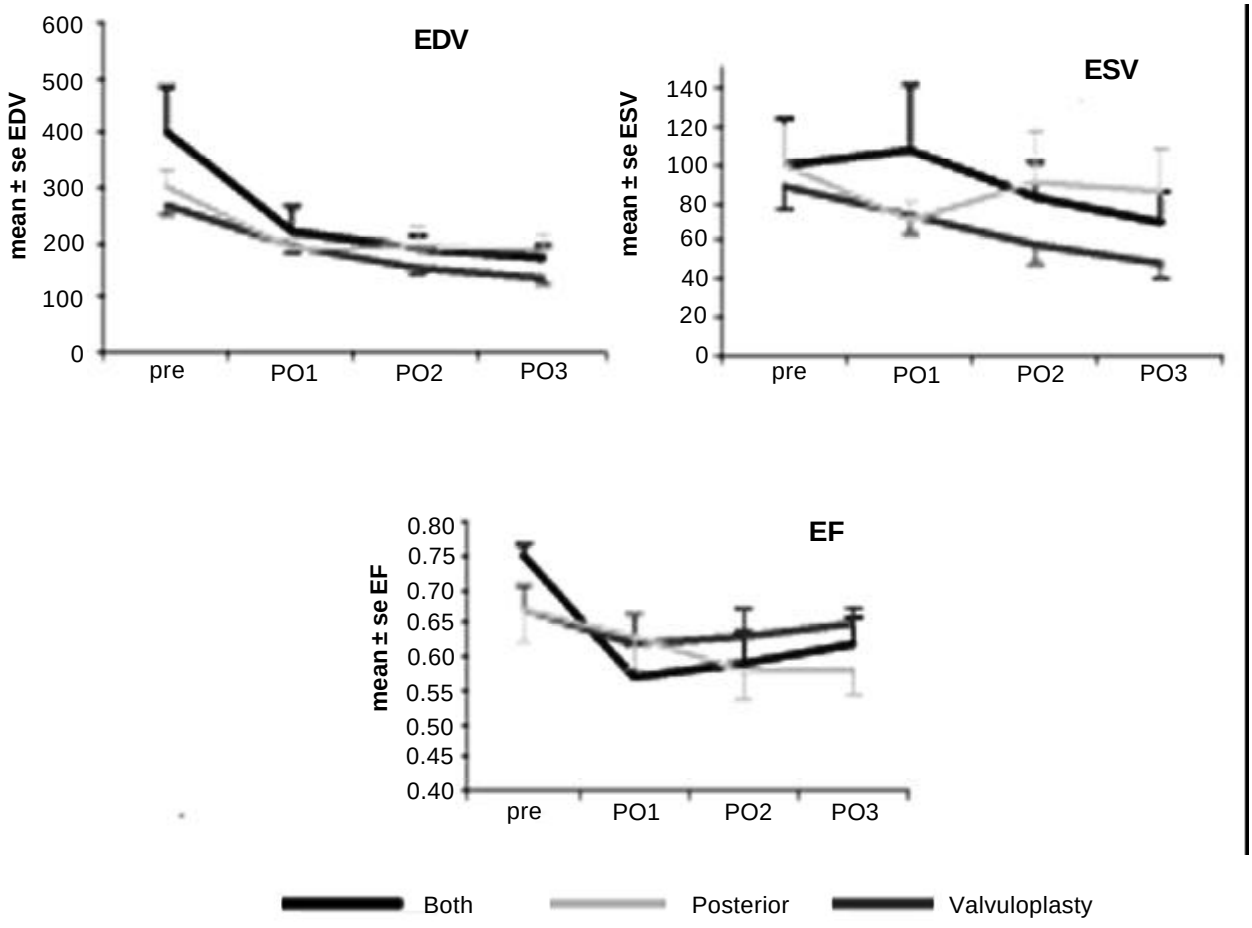
After correction of mitral insufficiency, both through valvuloplasty and prosthesis implantation, the first consequence was a reduction in the left ventricular diameter and end-diastolic volume, due to the elimination of the blood volume that circulated only between the left atrium and the left ventricle. A maximal reduction occurred already in the first postoperative week, detected on transthoracic Doppler echocardiography. Although the drop remained significant for up to 6 months, in this period its magnitude was small. The radionuclide ventriculography also detected a reduction in the end-diastolic volume at 6 months, with significantly lower values in the valvuloplasty group. These data are in accordance with the improvement in clinical findings and in functional class observed in the postoperative period.

Although removal of the regurgitating volume has a direct repercussion in the left ventricular end-diastolic volume, the same does not occur in regard to end-systolic volume, which is more dependent on the degree of preoperative myocardial contractility and afterload. It was not observed to change in patients undergoing mitral valve replacement with chordal preservation, which led to a reduction in ejection fraction. Only the patients in the valvuloplasty group had a significant drop in end-systolic volume, with no reduction in the ejection fraction. In accordance with these results, Corin et al [14] reported reductions in the EDV, both in patients undergoing valvuloplasty and in those undergoing mitral valve replacement with chordal preservation. Rozich et al [15] reported a drop in end-systolic volume with maintenance of the annulopapillary continuity. In this group, we solely observed a tendency towards such behavior. Our data do not agree with those by Yun et al [16], who observed an increase in end-systolic volume in the group undergoing chordal preservation of the posterior leaflet, and a reduction in that with chordal preservation in both leaflets. Usually, this effect is observed only in the postoperative period of mitral valvuloplasty, as in our case series.

The predictive value of the preoperative ejection fraction in late survival is consistent with some studies and has proved to be a strong indicator of left ventricular function in the postoperative period. The drop in ejection fraction below 0.55 in significant mitral insufficiency may be a clear indication of heart failure [17]. According to Depace et al [18], only the end-systolic diameter has an independent predictive value for the postoperative evolution in mitral valve replacement with chordal preservation. Six patients had left ventricular end-systolic diameter > 55 mm in the preoperative period. Of them, 3 had ejection fraction < 0.55 and only 2 improved their indices in the postoperative period. Although not using indices independent of the load, our results suggest that ventricular performance drops immediately after mitral valve replacement with chordal preservation (in both groups), which does not occur with the patients undergoing valvuloplasty.

Data about right ventricular ejection fraction observed on radionuclide ventriculography agree with those reported by Le Tourneau et al [19] about a drop in the ejection fraction and unaltered right ventricular ejection fraction in 23 patients undergoing mitral valve replacement with chordal preservation of the posterior leaflet.

The myxomatous degeneration severely affects the mechanical properties of the mitral chordae. Barber et al [20] mechanically tested segments of normal and myxomatous chordae, and reported that the myxomatous chordae were defective with half the load of the normal chordae, explaining the frequent rupture of myxomatous valves. The findings suggest that the procedures of chordal preservation



EDV = end-diastolic volume (mm^3); ESV = end-systolic volume (mm^3); EF = LV ejection fraction

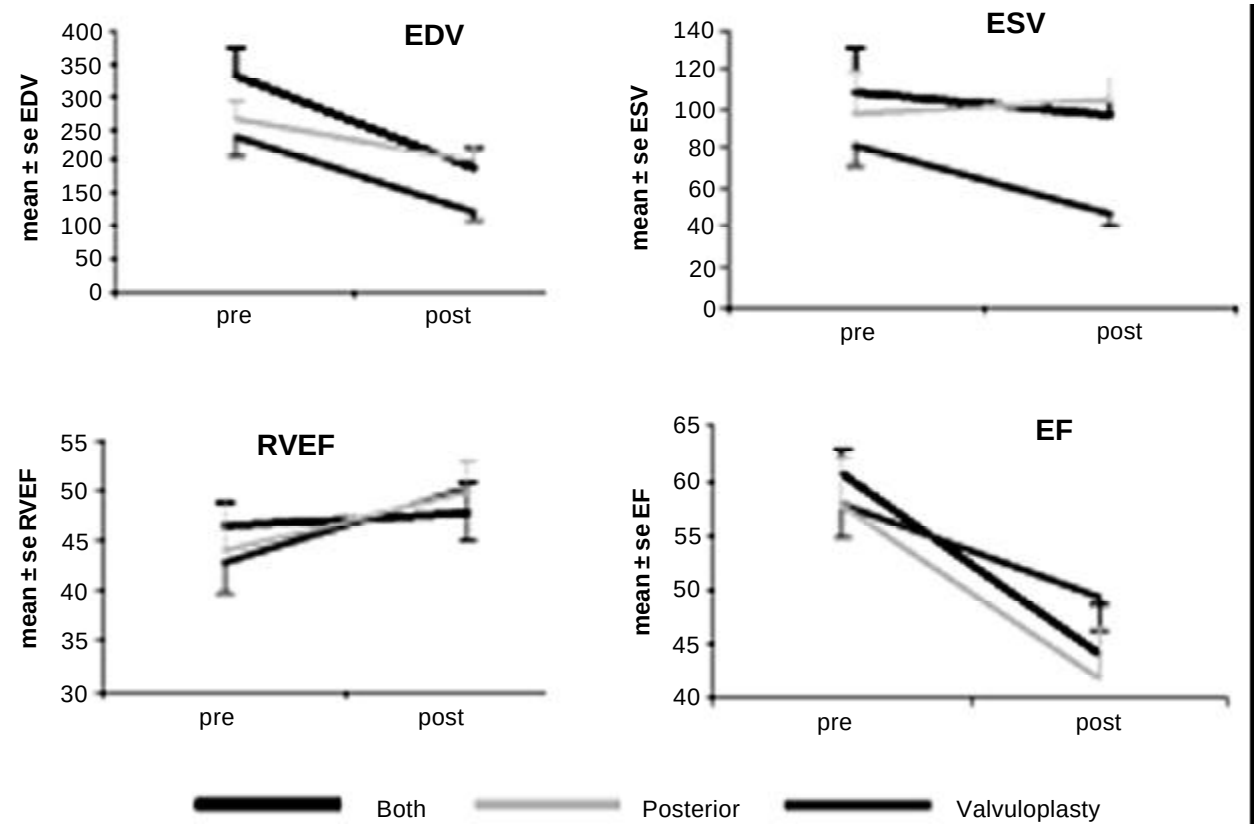
Chart IV - Evolutionary curves of EDV, ESV, and EF on echocardiography.

should be carefully performed, because they are abnormal and have impaired mechanical strength. In this study, only 6 of the 21 valves with the anatomicopathological diagnosis of myxomatous degeneration could be preserved, due to their intraoperative anatomical characteristics; the remaining underwent prosthesis implantation.

Of the 9 patients undergoing valvuloplasty, 7 underwent quadrangular resection and 2 underwent posterior annuloplasty with bovine pericardial patch. These procedures are justified by the fact that they correspond to 61.3% of all valvuloplasty procedures at the institution in the 17-year study period, according to Pomerantzeff et al [21].

Reports on dynamic or permanent obstruction of the left ventricular outflow tract emphasize that it is more frequently caused by overestimation of the size of the prosthesis or unnecessary retention of a large portion of the anterior leaflet that cannot be plicated. Prostheses of the basculate disk are susceptible to obstruction of the free movement of the disk by chordal remnants, and it is important to avoid locking of the disk caused by an eventual elongated or redundant chord, when techniques for chordal preservation are used [22]. In addition, locking of the disks after rupture of preserved chordae relating to the posterior leaflet has been reported [23]. The experience of the surgeons with double-valve (aortic and mitral) replacement procedures enabled the visualization of the left ventricular cavity through aortic opening and the observation of the relation of the retained structures of the anterior leaflet to the left ventricle outflow tract. The obstruction becomes a problem only when an excessive amount of tissue of the anterior leaflet remains in the ventricular side of the mitral ring. The posterior leaflet, almost always flexible, may be completely preserved, as may the chordae tendineae.

In regard to the surgical technique used in this study, the following considerations are applicable: 1) in the patients of the group of both leaflets, we tried to create a wide space for the implantation of an adequately sized prosthesis, through the wide resection of the translucent zone of the anterior leaflet and division of the posterior leaflet between the insertions; 2) the excessive traction of the chordae may cause their rupture or that of the papillary muscle, and the degree of tension after suture distension and the superposition of the respective leaflets to the mitral ring should be observed; 3) any obstruction of the left ventricular outflow tract should be avoided and the free movement of the prosthetic leaflets should be guaranteed through the fi-



EDV = end-diastolic volume (mm³); ESV = end-systolic volume (mm³); RVEF = right ventricular ejection fraction; EF = LV ejection fraction.

Chart V - Evolutionary curves of EDV, ESV, RVEF, and EF on gated radionuclide ventriculography.

Table IV - Distribution of the anatomicopathological diagnosis

Diagnosis	Groups			Total (%)
	Both	Posterior	Valvuloplasty	
Myxomatous degeneration	8	7	6	21 (77.8)
Rheumatic disease	1	2	2	5 (18.5)
Infective endocarditis	1	-	-	1 (3.7)
Total	10	9	8	27 (100)

P (Fisher exact test) = 0.9416.

xation of the groups of chordae relating to the anterior leaflet in each respective commissure and through the resection of an eventual excess of tissue in the posterior leaflet; 4) to reinforce possible areas of dehiscences created by resections and plications, the use of additional "U" or "8" stitches anchored in Teflon® is recommended in the suspicious areas; 5) we emphasize the value of intraoperative transesophageal Doppler echocardiography, which facilitates the identification and quantification of an occasional obstruction still in a phase in which stitch placement could be reviewed and modified. Taking this into consideration and that the left ventricular outflow tract gradient was not recorded, the qualitative analysis required no reintervention in any patient in the series.

A surgical mortality ranging from zero to 9.5% for the groups undergoing mitral valve replacement with chordal preservation has been reported[24,25]. In our study, the only patient who died belonged to the group of both leaflets and the cause of death was not directly related to the heart; our mortality rate, however, was 5.3% (1/19 patients with chordal preservation), similar to the overall mean. Six patients required vasoactive drugs for more than 24 hours after surgery; none, however, had prolonged low output syndrome.

In conclusion, considering physical activity, the 3 techniques of surgical correction provided an improvement in patients, and better preservation of ventricular function was observed in the patients undergoing valvuloplasty. No significant difference was observed in the laboratory results in the 2 groups of patients undergoing valve replacement with chordal preservation up to the sixth month of follow-up.

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References

1. David TE, Uden DE, Strauss HD. The importance of the mitral apparatus in left ventricular function after correction of mitral regurgitation. Circulation 1983; 68: 76-82.
2. Hetzer R, Bougiokas G, Franz M, Borst HG. Mitral valve replacement with preservation of papillary muscles and chordae tendinae – revival of a seemingly forgotten concept. Thorac Cardiovasc Surg 1983; 31: 291-6.
3. Lillehei CW, Levy MJ, Bonnabeau RC Jr. Mitral valve replacement with preservation of papillary muscles and chordae tendinae. J Thorac Cardiovasc Surg 1964; 47: 532-43.
4. Hennein HA, Swain JA, Mcintosh CL, Bonow RO, Stone CD, Clark RE. Comparative assessment of chordal preservation versus chordal ressection during mitral valve replacement. J Thorac Cardiovasc Surg 1990; 99: 828-37.
5. Straub U, Huwer H, Kalweit G, Volkmer I, Gams E. Improved regional left ventricular performance in mitral valve replacement with orthotopic refixation of the anterior mitral leaflet. J Heart Valve Dis 1997; 6: 395-403.
6. Hassouna A, Elmahalawi N. Valve replacement in rheumatic mitral incompetence: total versus posterior chordal preservation. Thorac Cardiovasc Surg 1998; 6: 133-8.
7. Yun KL, Sintek CF, Miller DC, et al. Randomized trial comparing partial versus complete chordal-sparing mitral valve replacement: effects on left ventricular volume and function. J Thorac Cardiovasc Surg 2002; 123: 707-14.
8. Miki S, Kusuhara K, Ueda Y, Komeda M, Okita Y, Tahata T. Mitral valve replacement with preservation of chordae tendineae and papillary muscles. Ann Thorac Surg 1988; 45: 28-34.
9. Rosner B. Fundamentals of Biostatistics, PWS Publishers, Massachusetts, 2nd Edition, 1986: 467-72.
10. Timm NH. Multivariate Analysis with Applications in Educations and Psychology. Belmont: Wadsworth Publishing Company, 1975: 444-71.
11. Rosner B. Fundamentals of Biostatistics, PWS Publishers, Massachusetts, 2nd Edition, 1986: 326-32.
12. Pomerantzeff PM, Brandao CM, Souza LR et al. Posterior mitral leaflet repair with a simple segmental annulus support: the 'double-Teflon technique'. J Heart Valve Dis 2002; 11(2): 160-4.
13. Braunwald E. Valvular heart disease. In: Heart Disease: A Textbook of Cardiovascular Medicine, vol 2, 5th ed, Braunwald E, ed, WB Saunders and Co, Philadelphia, 1997: 1017-29.
14. Corin WJ, Monrad ES, Murakami T, Nonogi H, Hess OM, Krayenbuehl H. The relationship of afterload to ejection performance in chronic mitral regurgitation. Circulation 1987; 76: 59-67.
15. Rozich JD, Carabello BA, Usher BW, Kratz JM, Bell AE, Zile MR. Mitral valve replacement with and without chordal preservation in patients with chronic mitral regurgitation. Mechanisms for differences in postoperative ejection performance. Circulation 1992; 86: 1718-26.
16. Yun KL, Sintek CF, Miller DC, et al. Randomized trial of partial versus complete chordal preservation methods of mitral valve replacement. A preliminary report. Circulation 1999; 100 (Suppl. II): II 90-4.
17. Michel PL. Mitral insufficiency. In: Textbook of Acquired Heart Valve Disease, 1st ed, Acar J, Bodnar E eds, ICR Pub, London, 1995: 403-32.
18. Depace NL, Ren JG, Iskandrian AS, Kolter MN, Hakki AH, Segal BL. Correlation of echocardiographic wall stress and left ventricular pressure and function in aortic stenosis. Circulation 1983; 67: 854-9.
19. Le Tourneau T, Grandmougin D, Foucher C et al. Anterior chordal transection impairs not only regional left ventricular function but also regional right ventricular function in mitral regurgitation. Circulation 2001; 104 (12 Suppl 1): I 41-6.
20. Barber JE, Ratliff NB, Cosgrove DMIii, Griffin BP, Vesely I. Myxomatous mitral valve chordae: mechanical properties. J Heart Valve Dis 2001; 10: 320-4.
21. Pomerantzeff PM, Brandao CM, Faber CN et al. Plástica da valva mitral: resultados aos 17 anos de experiência. Rev Bras Cir Cardiovasc 1999; 14: 185-90.
22. Dottori V, Barberis L, Lijoi A et al. Initial experience with mitral valve replacement with total preservation of both valve leaflets. Texas Heart Inst. J 1994; 21: 215-9.
23. Mok CK, Cheung DLC, Chiu CSW et al. An unusual lethal complication of preservation of chordae tendineae in mitral valve replacement. J Thorac Cardiovasc Surg 1988; 95: 534.
24. Popovic Z, Barac I, Jovic M, Panic G, Miric M, Bojic M. Ventricular performance following valve replacement for chronic mitral regurgitation: importance of chordal preservation. J Cardiovasc Surg 1999; 40: 183-90.
25. Straub U, Huwer H, Kalweit G, Volkmer I, Gams E. Improved regional left ventricular performance in mitral valve replacement with orthotopic refixation of the anterior mitral leaflet. J Heart Valve Dis 1997; 6: 395-403.