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Right Anterolateral Minithoracotomy Versus Median Sternotomy in Mitral Valve Replacement

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Abstract

Background: The mitral valve has been traditionally approached through a median sternotomy. However, significant advances in surgical optics, instrumentation, tissue tele manipulation, and perfusion technology have allowed for mitral valve surgery to be performed using progressively smaller incisions including the minithoracotomy.

Aim of Study: To compare the surgical outcome of right anterolateral minithoracotomy and median sternotomy in mitral valve replacement.

Patients and Methods: This study was done in department of Cardiothoracic surgery at El-Hussen Hospital, Al-Azhar University, after approval of the local ethical committee in the period between December 2016 till December 2017.

30 patients with MVD requiring mitral valve surgery were included in the study for operative and short term postoperative results to evaluate the impact of two approaches of replacement on functional status and Quality of Life of those patients who survived the operation will be studied.

Results: The thirty patients were divided into two groups where fifteen patients underwent mitral valve surgery via Rt anterolateral minithoracotomy operations rely on direct vision (6-12cm) with femoral artery and vein cannulation, these patients had better cosmoses in the early and the short term postoperative period.

Conclusion: It is obvious that not only better cosmoses drive surgeons to perform less invasive cardiac surgical procedures but the less invasive procedures are also intended to minimize harm to patients by reducing blood loss, reducing the amount of blood transfusion, reducing the danger of infection by minimizing wound dimensions, thereby shortening the patient's ICU and hospital stay.

Key Words: *Atrial fibrillation – Cardiopulmonary bypass.*

Introduction

MITRAL valve disease, particularly mitral regurgitation is the second-most-frequent valvular disease. Mitral valve repair, which includes ring annuloplasty in most cases, is the preferred intervention when feasible [1].

Sternotomy has been the gold standard in cardiac surgery and generally provides an unobstructed view of the heart. This is the currently used method in which all surgeons are trained and perform cardiac surgery across the world [2].

Minimally invasive approaches have been used with increasing frequency for mitral valve repair and replacement over the past 15 years [3].

A minimally invasive approach for mitral valve surgery via an minithoracotomy or port access is more cost-effective than median sternotomy, which is due to reductions in costs of cardiac imaging and laboratory tests, lower use of blood products, fewer perioperative infections, faster recovery, shorter hospital length of stay, fewer requirements for rehabilitation and lower readmission rates in the following postoperative year [4].

Minimally invasive mitral valve surgery has acceptable short- and long-term results in patients at high risks such as those who have undergone redo surgery, the elderly, those with renal impairment and infective endocarditis [я].

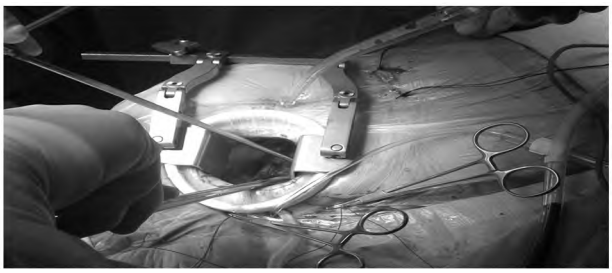

Fig. (1): Surgical field.

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Patients and Methods

In this study 30 patients with MVD requiring mitral valve surgery were non randomly selected.

Fifteen patients underwent mitral valve surgery via standard median sternotomy, the other 15 patients via level I less invasive surgery. Rt anterolateral minithoracotomy operations rely on direct vision (6-12cm) with femoral artery and vein cannulation.

Both groups were operated in elhussin hospital.

The study was performed during the time from (December 2016 till December 2017).

Inclusion criteria:

Adult patients with mitral valve disease with or without tricuspid valve disease.

Exclusion criteria:

1- Patients with coronary artery disease.
2- Patients with other valvular heart disease.
3- Patients with congenital heart disease.
4- Obese patients.
5- Children with small body surface area.

Patients were divided into two groups:

- Group I (control group) 30 patients had mitral valve replacement through median sternotomy and central cannulation for standard cardiopulmonary bypass.
- Group II (study group) 30 patients had mitral valve replacement through right anterior small thoracotomy (6-12cm via the right 4 th intercostal space) and peripheral cannulation via femoral vessels.

All our patients will be subjected to:

A- *Preoperative assessment:*

- History taking.
- Clinical examination.
- Laboratory work up.
- Chest X-ray.
- Electrocardiography (ECG).
- Echocardiography describing detailed cardiac anatomy and pathology.

B- Intraoperative assessment:

Includes total operation time, total bypass time, cross clamp time and intraoperative complications.

C- Postoperative assessment:

- ICU data and medications including the need for inotropic support.
- Postoperative complications specially:
  a- Bleeding and the need for re-exploration.
  b- Lung collapse, pulmonary contusion, and/or air leak.
  c- Wound Infection and/or seroma.
  d- Mortality.
- Hospital stay.
- Early postoperative results including echocardiography data before discharge and the need for medical treatment.
- Assessment of cosmosis, patient perception and satisfaction.

The following data were recorded for statistical analysis:

- Demographic data and clinical characteristics.
- Preoperative NYHA classification.
- Echocardiography finding.

Results

I- *Preoperative assessment:*

A- Demographic data and clinical characteristics of the patients.

B- Clinical classification.

C- Preoperative echocardiogrphic assessment:

Preoperative assessment in group I there was 8 cases (53%) of mitral stenosis, 5 cases (33%) of mitral regurge and 2 cases (14%) with a double mitral lesion. In group II showed that 8 patients (53%) suffered from isolated mitral stenosis, 6 (40%) patients had isolated mitral regurge and 1 patient (7%) had a double mitral valve lesion. with no statistical significance between the two groups (p-value >0.05).

Preoperative echocardiographic assessment shows that the ejection fraction (EF) in group "I" it was 61.35±5.02% with a p-value >0.05, while in group "II" was 64.35 ±6.40%. The left atrial dimension in group "I" it was 4.9 ±0.59 and in group "II" was 5.025±0.52, pulmonary artery pressure in group "I" it was 40.75 ± 12.96, while in group "II" was 42.6± 11.9 with a p-value >0.05. The left ventricular end diastolic dimension was 5.07±0.85cm in group "I" and in group "II" was 5.23±0.7cm with p-value >0.05. While the left ventricular end systolic dimension was 3.25 ±0.6cm in group "I" and 3.51 ±0.59cm in group "II" with no statistical difference between the 2 groups.

II- *Intra operative resullts:*

A- *Operative times:*

- Cannulation, Cross clamp and bypass time.
- Total operative times.

B- *Incision length:*

The length of the incision was compared in the two groups. The mean length of incision in group "I" was 22.47±2.23cm ranged from 19 to 26cm. While in group "II" the mean length was 6.92±0.93cm ranged from 6 to 12cm with p-value <0.01).

III- *Post operative results:*

A- Intensive care events:

All patients in both groups required post-operative mechanical ventilation.

The blood drainage and blood transfusion required to keep a Hematocrite around 25-30% was comparable in both groups.

The total intensive care unit (ICU) stay was comparable in both groups.

B- Post-intensive care course:

- Post-Operative pain.
- Post-operative complications.
- Early post- operative.

Wound satisfaction was comparable in the two group shows that 13 cases (87%) not satisfied about their wound scar and only 2 case (13%) were satisfied about their wound scar, while 14 cases (93%) of group (II) were satisfied about their wound scar after minithoracotomy which was very small compared to wound scar after sternotomy. The p-value was less than 0.0001 denoting that there was highly statistically significant difference between two group.

Post operative 3 month follow-up:

- Incision and patient satisfaction.
- Pain score:

After 3 months the pain score using the visual analogue scale was compared in the two groups. Pain score in group (I) was 3.45±0.998, in group (II) the mean pain score was 1.6±0.68 with highly statistically significance difference.

Post operative 6 months follow-up:

- Incision and patients' satisfaction.
- Pain score.

Table (1): Demographic data and clinical characteristics of the patients.

	Group I	Group II	p-value	Sig.
Number	15	15		
Age:				
Range	22-50	17-57		
Mean ± SD	35.6±6.68	34.65±11.52	0.75	NS
Male %	40%	40%	>0.05	NS
BMI:				
Mean ± SD	23.82±2.99	22.30±2.83	0.13	NS

Table (2): Preoperative NYHA classification (Number & %).

	Group I	Group II	p-value	Sig.
I	1 (6%)	2 (14%)		
II	5 (34%)	6 (40%)		
III	9 (60%)	6 (40%)		
IV	0	1 (6 %)		
Mean ± SD	2.55±0.6	2.4±0.75	0.186	NS

Table (3): Cannulation & cross clamp & total bypass time in both groups.

	Group I	Group II	p-value	Sig.
Cannulation (min)	26.25±4.83	44.6±5.71	<0.01	HS
Cross Clamp (min)	57.05±11.90	86.3±24.96	<0.01	HS
Total Bypass (min)	86.2±15.68	121.4±17.31	<0.01	HS

Table (4): Total operation time in both groups.

	Group I	Group II	p-value	Sig.
Range (Hour)	3-5	4-6		
Mean ± SD	3.89±0.63	4.82±0.65	0.00001	HS

Table (5): Ventilation, blood loss, blood transfusion and total ICU stay.

	Group I	Group II	p-value	Sig.
Ventilation (hours):				
Range	4–12	3–6	0.0011	S
Mean ± SD	6.2±1.94	4.27±1.43		
Blood loss (ml):				
Range	250–1450	50–600	0.0002	HS
Mean ± SD	632.5±332.9	292±156.6		
Blood transfusion (unit):				
Range	1–6	1–3	<0.0001	HS
Mean ±SD	2.9±1.293	1.55±0.604		
ICU stay (day):				
Range	2–4	1.5–3	0.0370	S
Mean ± SD	2.65±0.87	2.15±0.56		

Table (6): Post-operative complications of both approaches.

	Group I	Group II	p-value	Sig.
No complications	7 (46%)	10 (66%)	>0.05	NS
Arrhythmias	6 (40%)	3 (20%)	>0.05	NS
Lung atelectasis	0	1 (7%)	>0.05	NS
Superficial wound infection	2 (14%)	1 (7%)	>0.05	NS

Table (7): Total hospital stay of both groups.

	Group I	Group II	*p*-value	Sig.
Total hospital stay:				
Range	6–12	5–9		
Mean ± SD	8.8±1.609	7.1±1.33	0.0008	HS

Table (8): Patients satisfaction about their wound scar.

	Group I	Group II	*p*-value	Sig.
Wound Satisfaction	2 (13%)	14 (93%)	<0.0001	HS

Table (9): Hypertrophic scar and patients satisfaction about their wound in both groups after 3 months post-operative.

	Group I	Group II	*p*-value	Sig.
Hypertrophic scar	3 (20%)	1 (7%)	>0.05	NS
Patients satisfaction	5 (33%)	14 (93%)	<0.01	HS

Table (10): 3 months follow-up echocardiographic assessments in both groups.

	Group I	Group II	*p*-value	Sig.
EF %	59.18±3.0	61.1	>0.05	NS
LA (CM)	4.73±0.41	4.76	>0.05	NS
LVED (CM)	5.07±0.85	5.23	>0.05	NS
LVES (CM)	3.46±0.57	3.68	>0.05	NS
PAP (mmhg)	36.67±10.6	39.57	>0.05	NS
Pericardial effusion	3 (20%)	1 (7%)	>0.05	NS

Table (11): Pain score after 3 months in both groups.

	Group I	Group II	*p*-value	Sig.
Pain score	3.45	1.6	<0.01	HS

Table (12): Hypertrophic scar and patients satisfaction about their wound after 6 months in both groups.

	Group I	Group II	*p*-value	Sig.
Hypertrophic scar	5 (33%)	1 (7%)	<0.05	S
Patients satisfaction	5 (33%)	14 (93%)	<0.01	HS

Table (13): 6 months follow-up echocardiographic assessments in both groups.

	Group I	Group II	*p*-value	Sig.
EF %	58.7±5.98	62.85±4.53	<0.05	S
LA (CM)	4.2±0.47	4.16±0.48	>0.05	NS
LVED (CM)	4.57±0.35	4.73±0.14	>0.05	NS
LVES (CM)	2.96±0.07	3.18±0.09	>0.05	NS
PAP (mmhg)	35.8±10.31	34.65±5.3	>0.05	NS
Pericardial effusion	2 (14%)	1 (7%)	>0.05	NS

Table (14): Pain score after 6 months in both groups.

	Group I	Group II	*p*-value	Sig.
Pain score	2.3	0.7	<0.01	HS

Table (15): Comparison between pre and post-operative trans-thoracic echocardiography in group I.

	Pre-operative	Post-operative	*p*-value	Sig.
EF %	61.35±5.02	58.7±5.98	>0.05	NS
LA (CM)	4.9±0.59	4.2±0.47	<0.01	HS
LVED (CM)	5.07±0.85	4.57±0.35	<0.05	S
LVES (CM)	3.25±0.6	2.96±0.07	<0.05	S
PAP (mmhg)	40.75±12.9	35.8±10.31	<0.05	S

Table (16): Comparison between preoperative and postoperative trans-thoracic echocardiography in group "II".

	Pre-operative	Post-operative	*p*-value	Sig.
EF %	64.35±6.40	62.85±4.53	>0.05	NS
LA (CM)	5.025±0.52	4. 16±0.48	<0.01	HS
LVED (CM)	5.23±0.7	4.73±0.14	<0.05	S
LVES (CM)	3.51±0.59	3.18±0.09	<0.05	S
PAP (mmhg)	42.6±11.9	34.65±11.06	<0.05	S

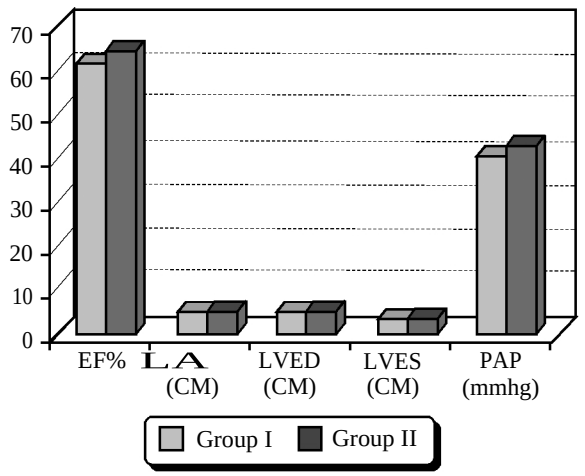

Fig. (2): Preoperative echocardiography in both groups.

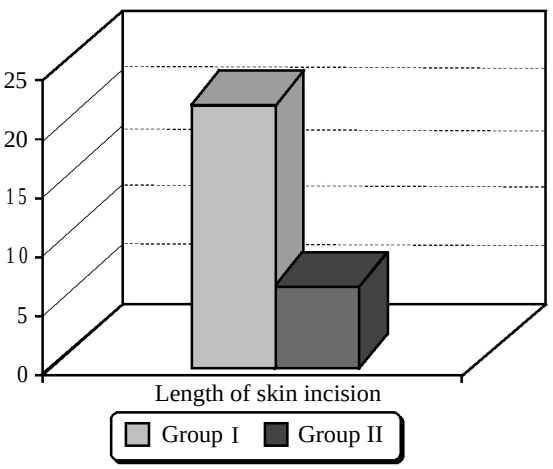

Fig. (3): Length of skin incision in both groups.

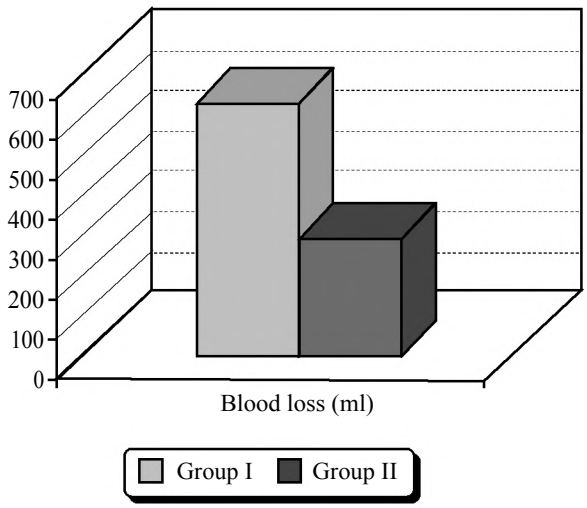

Fig. (4): Post-operative Blood loss in both groups.

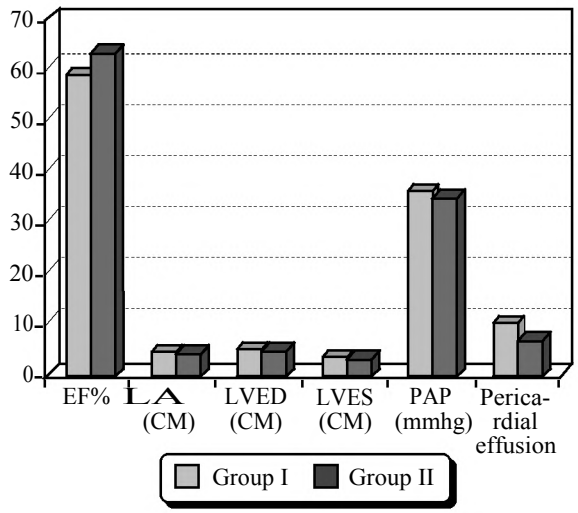

Fig. (7): 6 months Echocardiographic finding in both groups.

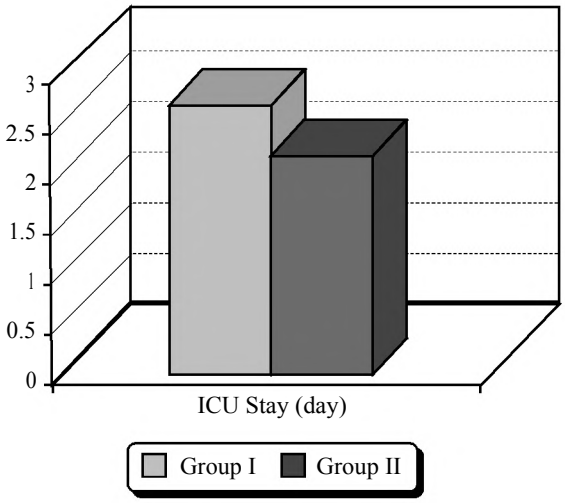

Fig. (5): Total ICU Stay in both groups.

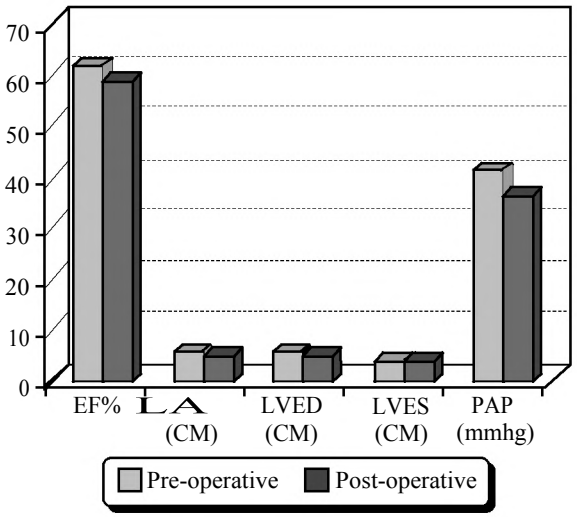

Fig. (8): Comparison between pre and post-operative trans-thoracic echocardiography in group I.

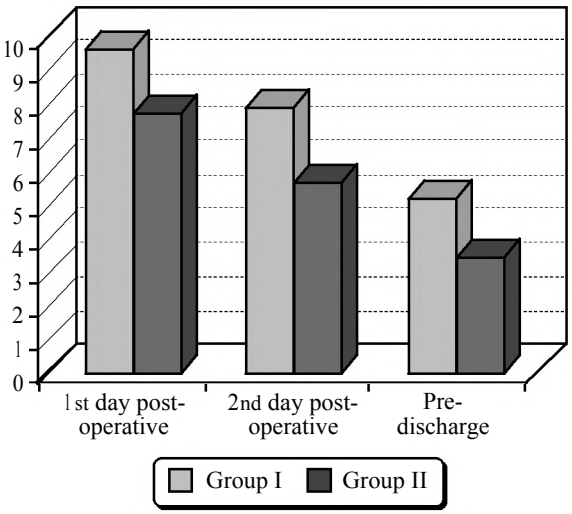

Fig. (6): Pain score in both groups.

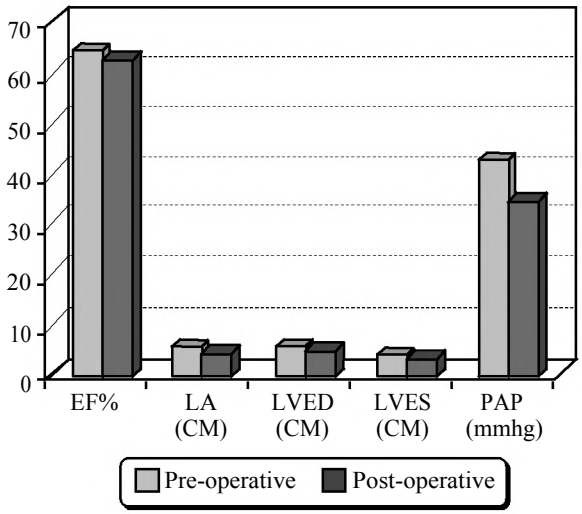

Fig. (9): Comparison between pre operative and postoperative trans-thoracic echocardiography in group "II".

Discussion

Full median sternotomy has been well established as a standard approach for all types of open heart surgery for many years. Although well established, the full sternotomy incision has been frequently criticized for its length, post-operative pain and possible complications like wound infection and instability [6].

Minimally invasive mitral valve surgery is safe, with low perioperative morbidity, and low rates of reoperation Minimally invasive mitral valve surgery has been proven a feasible alternative to the conventional full sternotomy approach with low perioperative morbidity and short-term mortality, Efforts to minimize surgical trauma, which hasten patient recovery and increase patient satisfaction, without compromise to surgical repair or replacement techniques, continue to be the rationale for minimally invasive procedures [7].

This study was conducted on 30 patients suffering from MVD selected non randomly (purposive non probability sample) to compare procedure and early outcome of traditional sternotomy versus less invasive technique.

Patients were selected from cardiothoracic department, El-Hussin Hospital. In Group I, a fifteen patients underwent mitral valve surgery by traditional sternotomy, In Group II, a fifteen patients by level I less invasive surgery Rt anterolateral minithoracotomy.

In our study, group (II) patients had femoral cannulation of the both femoral artery and vein; the cannulation was through the small 3-4cm transverse incision in the groin between the inguinal crease and the inguinal ligament. The femoral cannulation was easy in all patients. We did not need any aortic cannulation.

Several studies reported the use of femoral cannulation for arterial blood flow [8]. Also, we believe that the chief disadvantages of right minithoracotomy are the limited field and the relative inaccessibility for cannulation of the aorta [9].

Pain level after cardiac operations is relatively low in most patients. Such postoperative pain is bearable; the patients receive sufficient pain medication on request. The thoracic pain is of tolerable intensities if the sternum and the ribs are stable postoperatively. All patients suffered from pain during mobilization and coughing. This can be directly related to the thoracic incision and friction of the split sternum during these maneuvers [10].

In our study, the mean hospital stay was 8.8 ± 1.609 days in group “I” and 7.1 ± 1.33 days in group “II” this difference is statistically highly significant with a p-value<0.01. All the studies reported that hospital stay is significantly less in patients with minithoracotomy than those with sternotomy [8]. Reported a mean hospital stay of 5.9 ± 2 days in the thoracotomy group and 8.8 ± 3 days in the sternotomy group.

In our study, we did not discharge the patients before the 6th day, also the patients required adjustment a postoperative INR level and oral anticoagulant dosage for proper control of anticoagulation. Earlier discharge of low educated would be hazardous.

Conclusion:

In our less invasive study group, we achieved less mediastinal drainage and blood loss, so that less blood and blood products were required for transfusion. The ICU stay and hospital stay were significantly shorter in the study group, and there were fewer incidences of major complications such as wound infection and mediastinitis. Right anterolateral minithoracotomy provides excellent exposure of the mitral valve and offers a better cosmetic lateral scar.

It 's almost accepted alternative approach for median sternotomy in simplemitral valve surgery especially with well-trained surgeon and availability of the equipment.

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مقارنة بين الشق الصدرى الأمامى الأيمن المحدود وشق عظمة القص فى أستبدال الصمام الميترالى

يجب أن لا يكون المظهر الجمالى الأفضل للجروح هو ما يدفع الجراحين إلى إجراء الجراحات الأقل تدخلات من خلال فتحات صغيرة. لكن يجب أولا وضع سلامة المريض وأمانه وعدم تعرضه للمخاطر خلال وبعد الجراحة من أهم أولويات الجراح.

فإن إجراء جراحة الصمام الميترالى الأقل تدخلا من خلال الفتح الصدرى الجانبى كانت تستخدم بتوسع منذ بدايات التاريخ الجراحى للصمام الميترالى والقلب المفتوح.

ويعتبر ألتهاب عظمة القص من أخطر المضاعفات التى تحدث بعد جراحات القلب من خلال الفتح التقليدى. إن جراحة الصمام الميترالى الأقل تدخلا عن طريق الفتح الأمامى الجانبى الأيمن للصدر لن تكون فقط أكثر قبولاً للمريض من الناحية الجمالية للجرح، ولمن أيضاً سوف تجعل جراحات ثانية للقلب من خلال الشق الأوسط لعظمة القص، أسهل وخالية من المشاكل النزيف الجراحى أثناء الفتح.