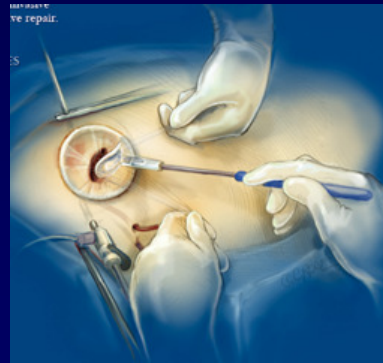


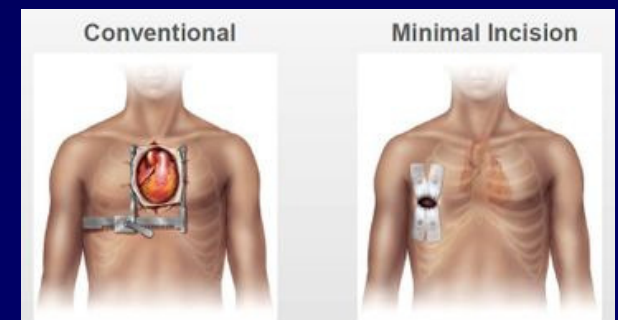
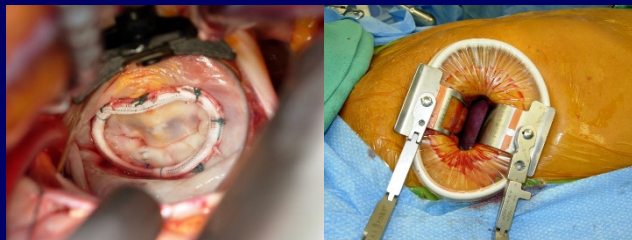
# Minimally Invasive Cardiac Surgery

Allen Cheng, M.D.\*

\*Surgical Director of Heart Failure and Mechanical Circulatory Support  
Division of Cardiothoracic Surgery  
Oklahoma Heart Institution



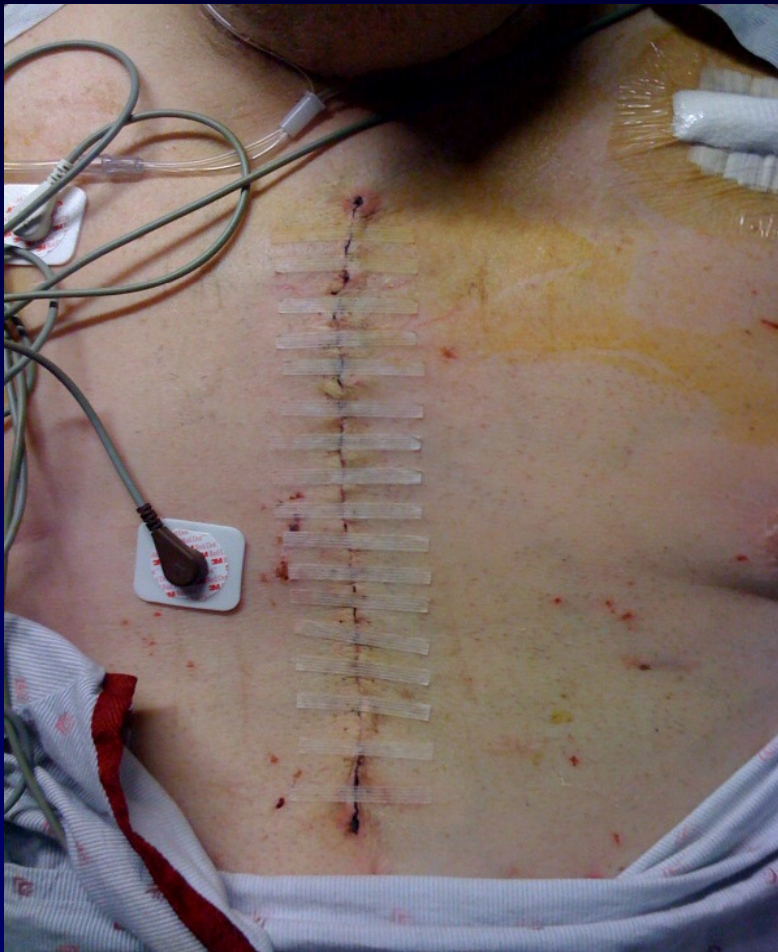
***Oklahoma Heart Institute 28<sup>th</sup>  
Annual Oklahoma Heart Update in  
Cardiology: Improving Outcomes  
for Cardiovascular Patients. May  
5<sup>th</sup> 2017. Tulsa, OK.***



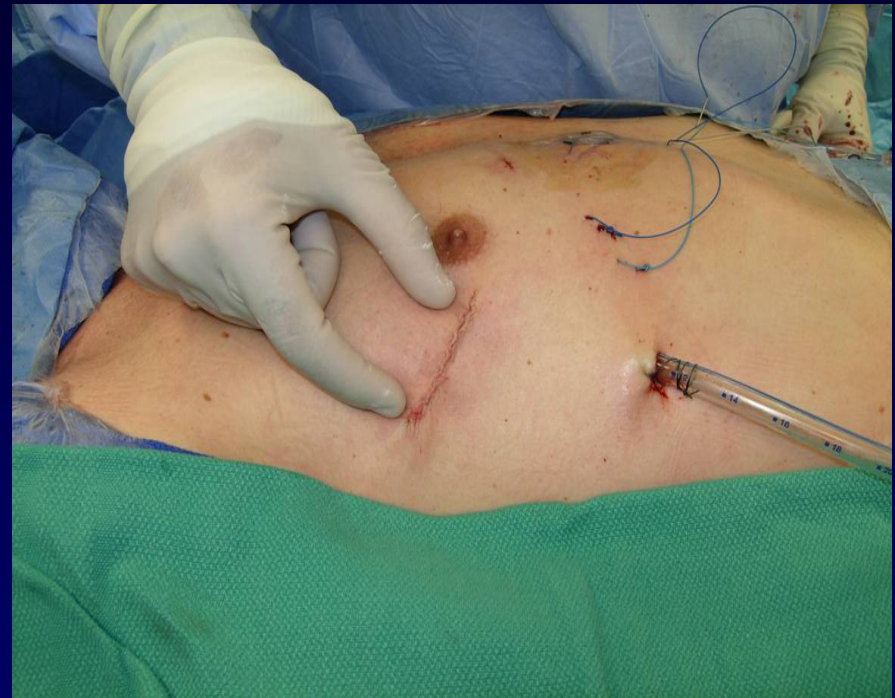
# Which incision do you prefer?

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Sternotomy



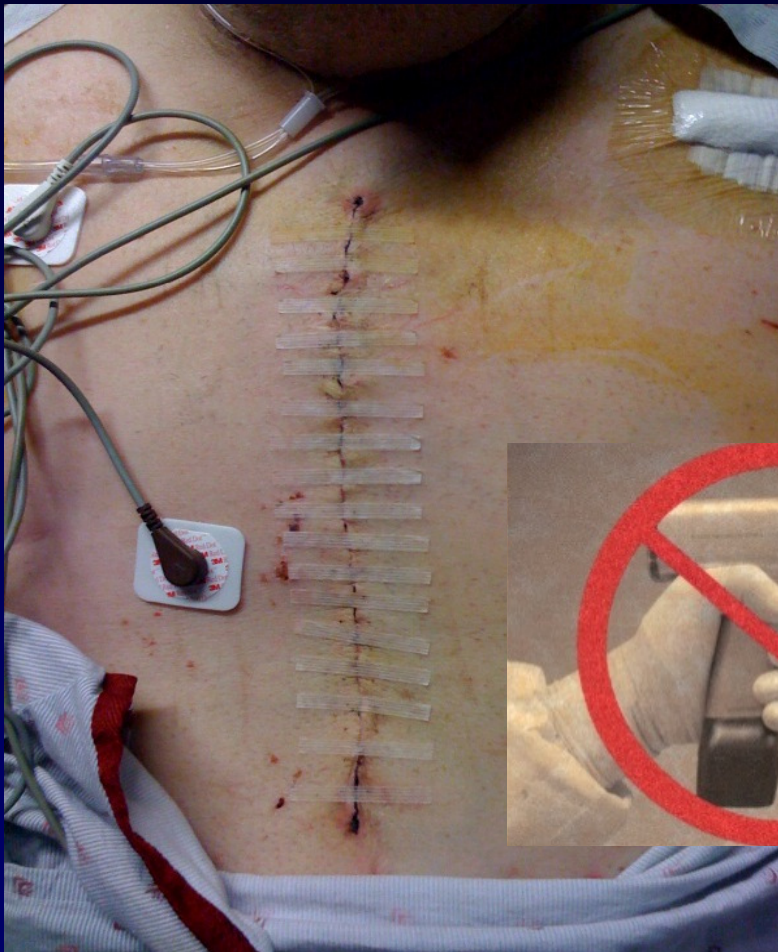
MIS



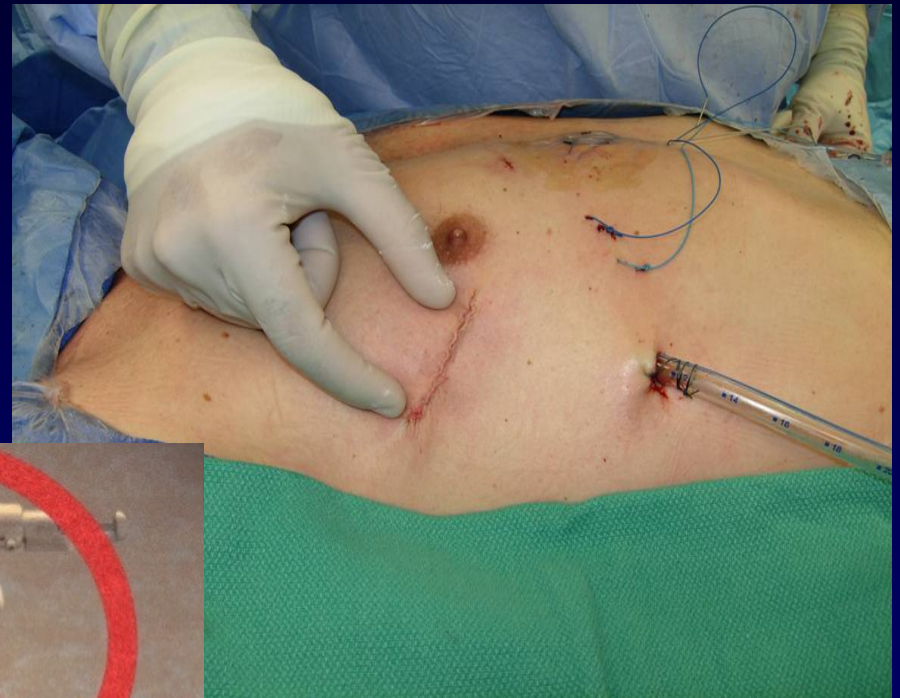


# Which incision do you prefer?

Sternotomy



MIS



# Introduction

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**Minimally invasive** cardiac valve surgery (**MIS**) is a procedure performed for repairing or replacing heart valves through a small incision under DIRECT vision. The procedure is performed through a right lateral (mitral, tricuspid, PFO, ASD, MAZE) or right anterior (aorta) mini-thoracotomy. Specialized instruments are used for the procedure to improve visibility. And femoral vessel cannulations are used for cardiopulmonary bypass.

# Full Sternotomy

# MIS

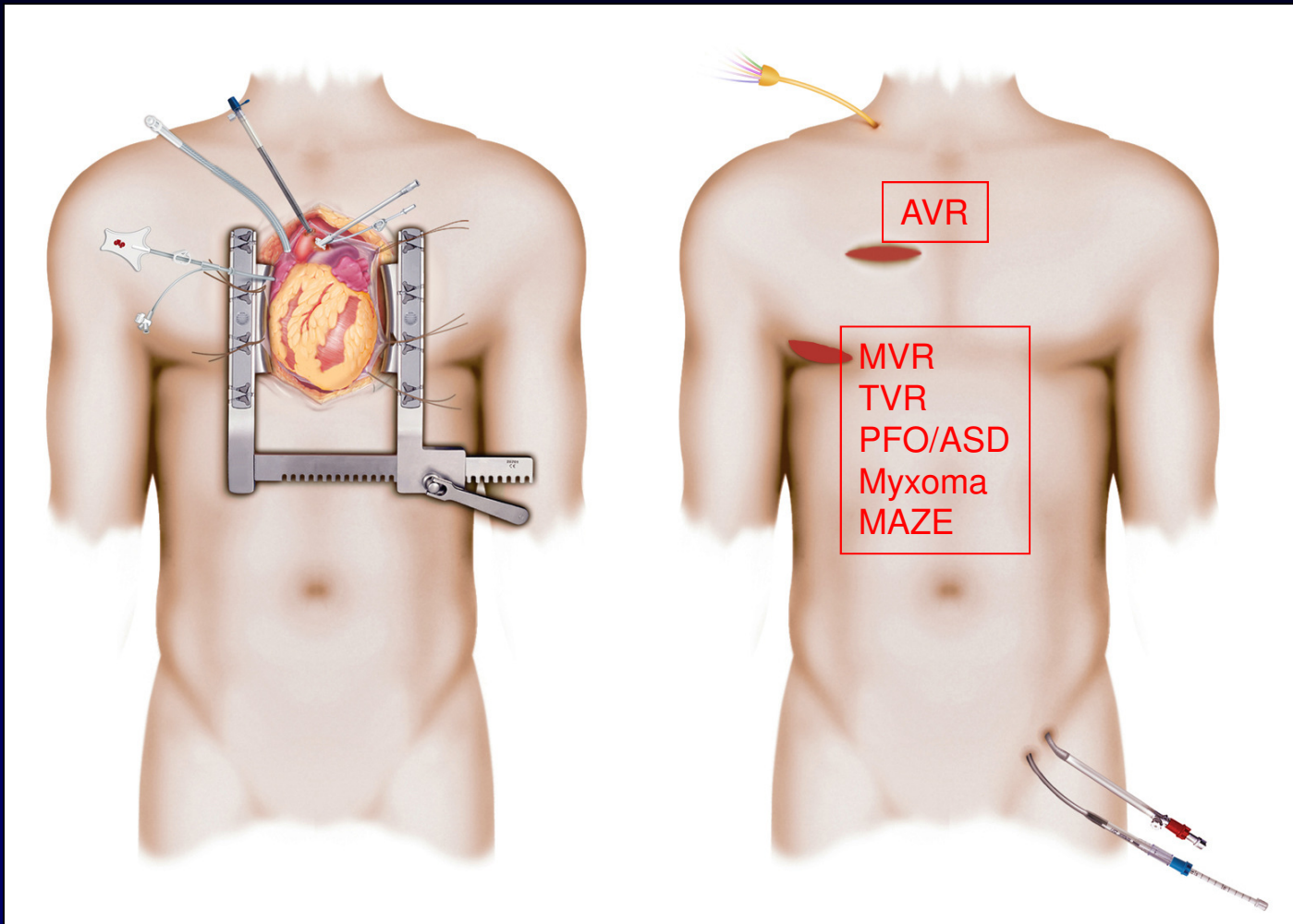
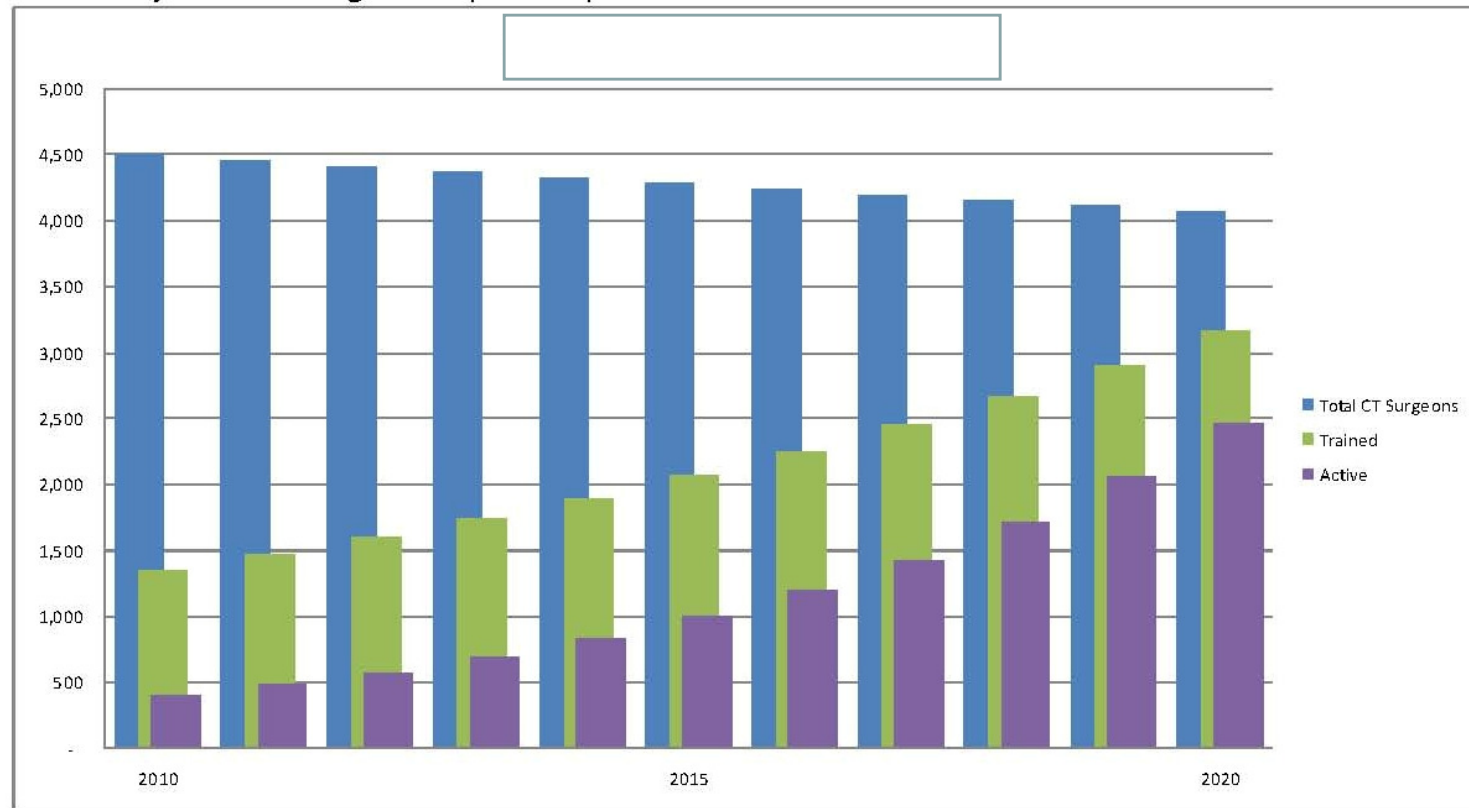


Figure 11: Projected MICS growth (level -I) trend United States.



Source: Report Estimate.

# A Decade of Minimally Invasive Mitral Repair: Long-Term Outcomes

Aubrey C. Galloway, MD, Charles F. Schwartz, MD, Greg H. Ribakove, MD, Gregory A. Crooke, MD, George Gogoladze, MD, Patricia Ursomanno, PhD, Margaret Mirabella, MSN, Alfred T. Culliford, MD, and Eugene A. Grossi, MD

Department of Cardiothoracic Surgery, New York University Medical Center, New York, New York

**N = 1601**

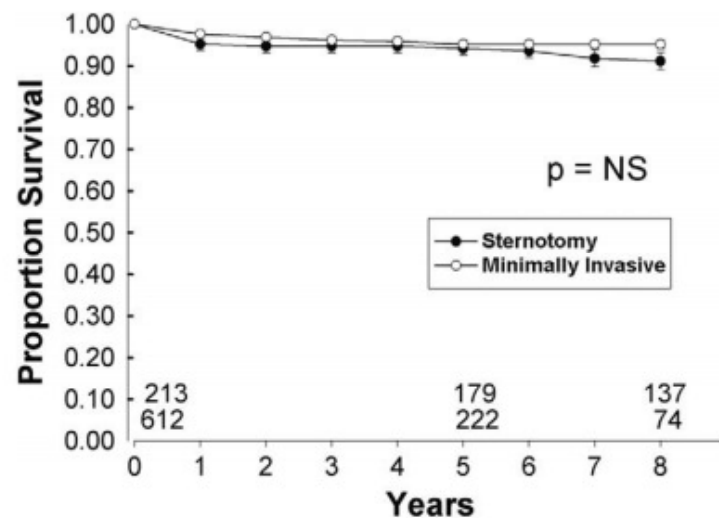


Fig 2. Comparison of standard sternotomy (solid circles) and minimally invasive approach (open circles) for freedom from reoperation in isolated mitral valve repairs. (NS = not significant.)

**Survival**

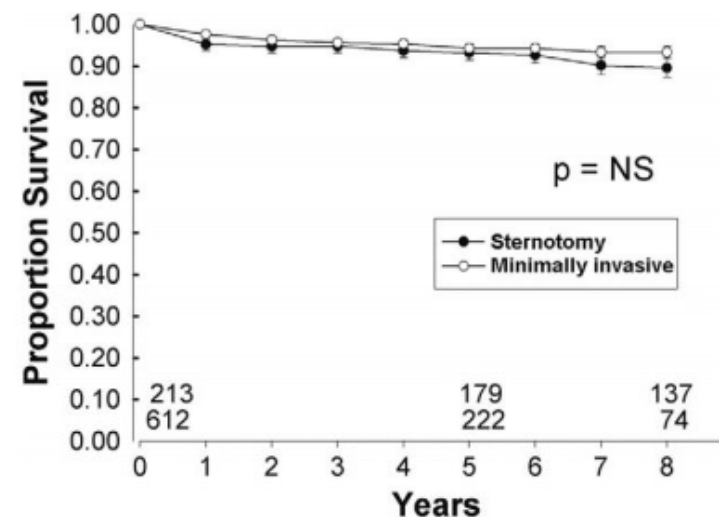


Fig 3. Comparison of standard sternotomy (solid circles) and minimally invasive approach (open circles) for freedom from reoperation or severe mitral insufficiency in isolated mitral valve repairs. (NS = not significant.)

**Freedom from Reoperation**

Galloway AC, Schwartz CF, Ribakove GH, et al. A decade of minimally invasive mitral repair: long-term outcomes. Ann Thorac Surg 2009;88:1180–4.

**MICS: 8-yr freedom from reoperation is 95%±1%**



## A minimally invasive approach is more cost-effective than a traditional sternotomy approach for mitral valve surgery

Alexander Iribarne, MD, MS,<sup>a</sup> Rachel Easterwood, BA,<sup>a</sup> Mark J. Russo, MD, MS,<sup>b</sup> Y. Claire Wang, MD, ScD,<sup>c</sup> Jonathan Yang, MD,<sup>a</sup> Kimberly N. Hong, MHA,<sup>a</sup> Craig R. Smith, MD,<sup>a</sup> and Michael Argenziano, MD<sup>a</sup>

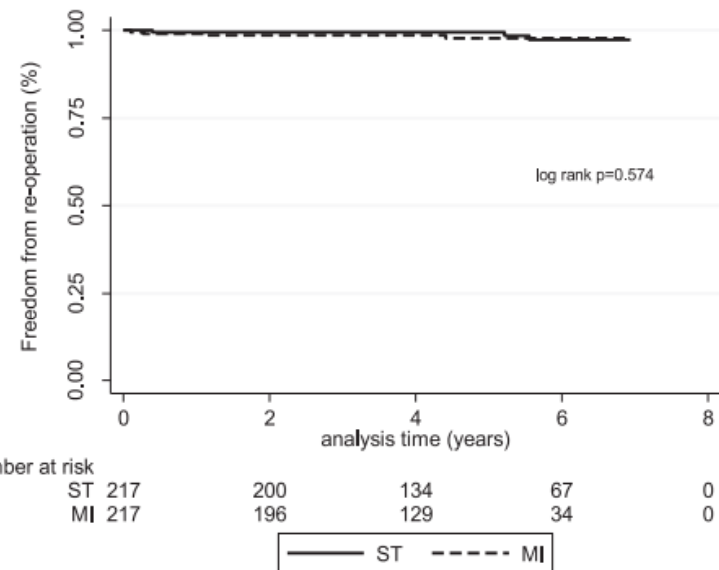
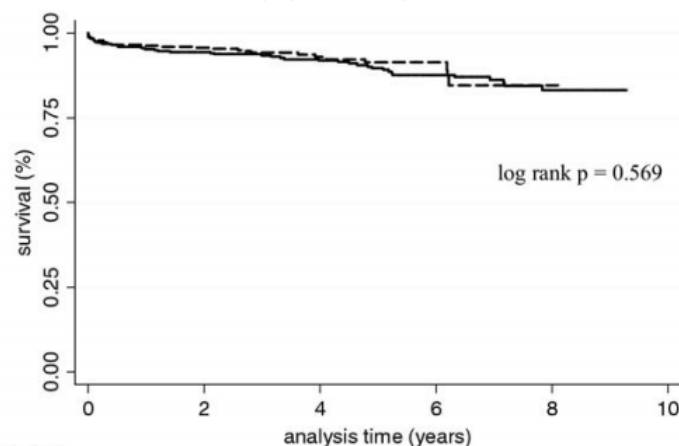
J Thorac Cardiovasc Surg 2011;142:1507-14

Columbia

N = 434 pts (217 MICS; 217 ST)

No differences in freedom from reoperation or long term survival (p = 0.334)

### Survival



**FIGURE 2.** Freedom from mitral valve reoperation. *ST*, Sternotomy; *MI*, minimally invasive. **Freedom from Reoperation**



No significant difference in the frequency of **post-op complications** between groups

**Shorter hospital stay:** Average length of stay 9.8 (ST) vs 7.7 (MIS) days (p=0.0043)

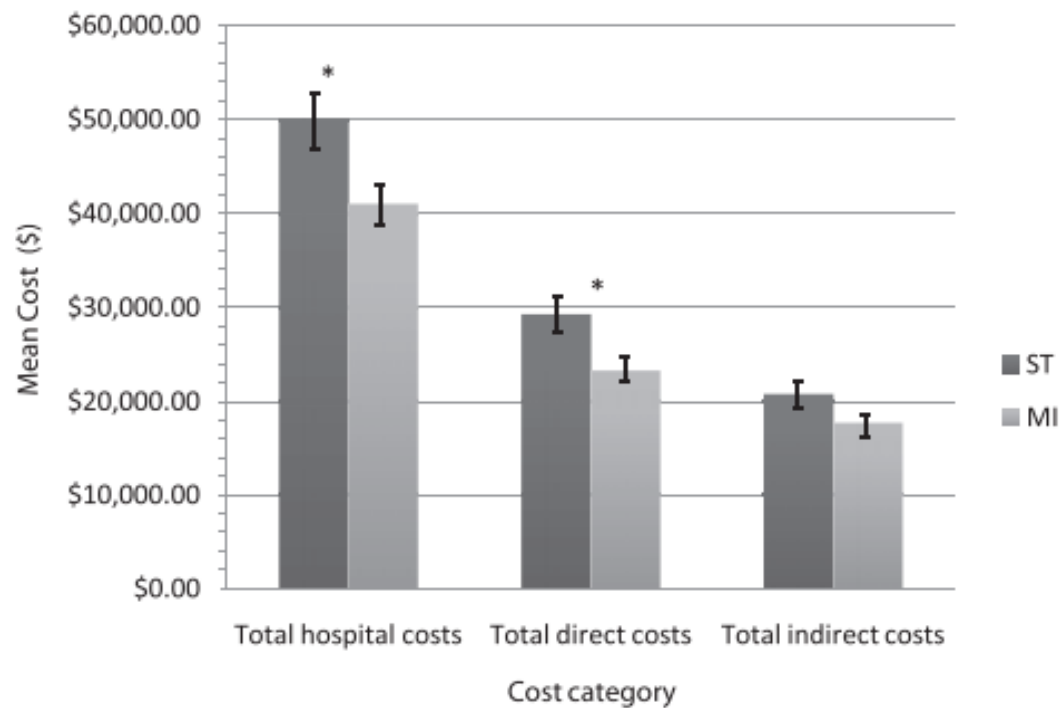
A higher proportion of MIS patients **discharge home** (p=0.018) instead of rehab

A **lower readmission** rate within 1 year (p=0.023)

**Lower Transfusion Rate**

**TABLE 6. In-hospital complications, short-term survival, discharge location, and readmissions**

	ST (n = 217)	MI (n = 217)	P value
<i>Complications</i>			
Gastrointestinal bleed	1 (0.46%)	1 (0.46%)	1.0
Intubation > 72 h	18 (8.3%)	6 (2.8%)	.019
Renal failure	6 (2.8%)	2 (0.92%)	.284
Reoperation for bleeding	7 (3.2%)	4 (1.8%)	.544
Sepsis	2 (0.92%)	3 (1.4%)	1.0
Stroke (< 24 h)	3 (1.4%)	1 (0.46%)	.623
Stroke (≥ 24 h)	4 (1.8%)	2 (0.92%)	.685
Transmural myocardial infarction	0	0	1.0
<i>Mortality</i>			
Thirty-day mortality	3 (1.4%)	6 (2.8%)	.503
One-year mortality	12 (5.5%)	10 (4.6%)	.827
<i>Discharge location</i>			
	(n = 204)	(n = 202)	
Home with no nursing services	111 (54.4%)	135 (66.8%)	.018
Home with nursing aide	63 (30.9%)	52 (25.7%)	
Skilled nursing facility	16 (7.8%)	5 (2.5%)	
Short-term, acute rehabilitation	2 (0.98%)	0	
Other rehabilitation facility	12 (5.9%)	10 (5.0%)	
<i>Readmission</i>			
	(n = 205)	(n = 207)	
No readmissions within 1 y	177 (86.3%)	193 (93.2%)	.023
≥ 1 readmission within 1 y	28 (13.7%)	14 (6.8%)	
Cardiac surgery	3 (10.7%)	2 (14.3%)	
Pacemaker insertion	4 (14.3%)	3 (21.4%)	
PCI	4 (14.3%)	1 (7.1%)	
Arrhythmia	6 (21.4%)	4 (28.6%)	
Chest pain or CHF	6 (21.4%)	1 (7.1%)	
CVA/TIA	2 (7.1%)	1 (7.1%)	
Pleural effusion	3 (10.7%)	2 (14.3%)	



J Thorac Cardiovasc Surg 2011;142:1507-14

MIS is associated with **\$9054 $\pm$ 3302/pt** lower mean total hospital cost (p=0.05)

**~250 procedures  
= ~US\$2.2M savings**

## Comparative effectiveness of minimally invasive versus traditional sternotomy mitral valve surgery in elderly patients

Alexander Iribarne, MD, MS,<sup>a</sup> Rachel Easterwood, BA,<sup>a</sup> Mark J. Russo, MD, MS,<sup>b</sup> Edward Y. Chan, MD,<sup>a</sup> Craig R. Smith, MD,<sup>a</sup> and Michael Argenziano, MD<sup>a</sup>

J Thorac Cardiovasc Surg 2012;143:S86-90

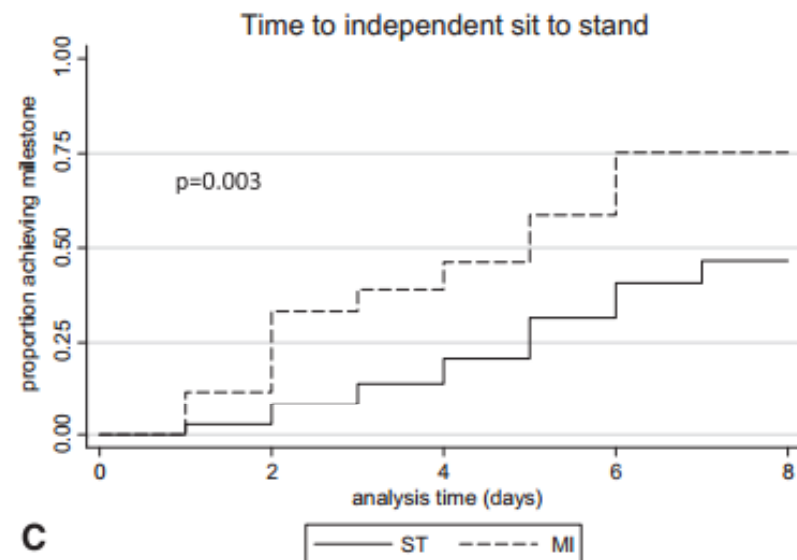
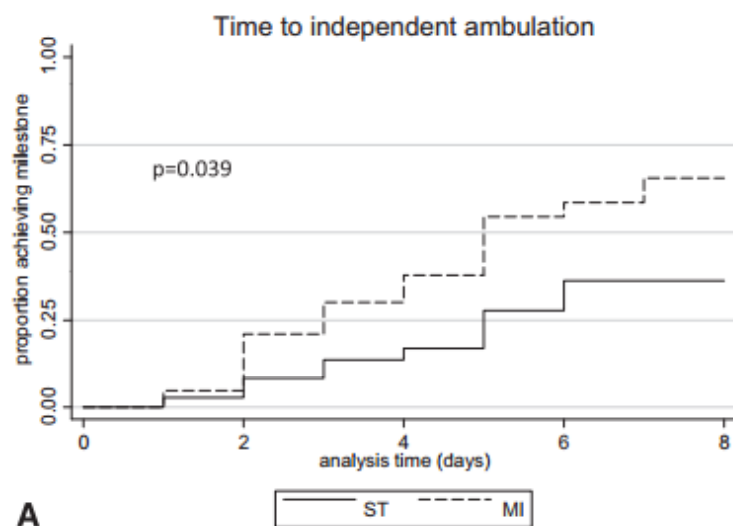
Pt > 75 y/o

No significant differences in rate of major **post-op complications** (p=0.1) and long-term survival (p = 0.6)

3.1 day **shorter hospital stay** (p=0.033)

MIC approach has more pt **discharge to home** than rehab (p=0.021)

MICS associated with **\$6721/pt lower median total cost** of hospitalization



J Thorac Cardiovasc Surg 2012;143:S86-90

Faster rate of ambulation ( $p=0.039$ )



## Featured Article

# Concomitant tricuspid valve repair in patients with minimally invasive mitral valve surgery

**Bettina Pfannmüller, Piroze Davierwala, Gregor Hirnle, Michael A. Borger, Martin Misfeld, Jens Garbade, Joerg Seeburger, Friedrich W. Mohr**

Department of Cardiac Surgery, Heart Center, University of Leipzig, Germany

*Corresponding to:* Dr. med. habil. Bettina Pfannmueller, MD, PhD. Department of Cardiac Surgery, Heart Center, University of Leipzig, Struempellstrasse 39, 04289 Leipzig, Germany. Email: pfab@med.uni-leipzig.de.

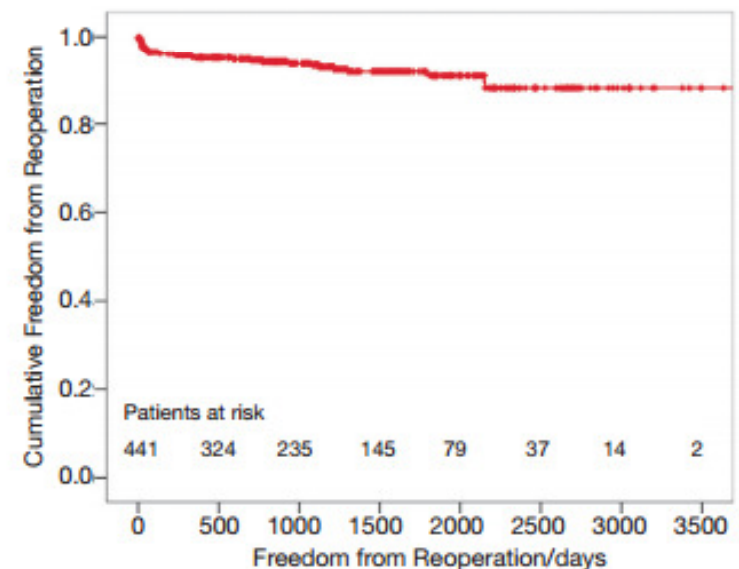
Double valves

N = 441 pt with MVR + TVR

Overall 30 days mortality was 4.3%

Freedom from reoperation was 91%

Combine TV surgery can be done safely and routinely with good perioperative results.



**Figure 4** Kaplan-Meier estimated freedom from reoperation.

# Minimally Invasive Cardiac Surgery

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## Benefits

Avoid Sternotomy (no sternotomy associated morbidity)

Smaller Incision/ Better cosmetics

Improve patients' acceptance of surgery, more patients referral

Shorter recovery time and more rapid return to normal activity level

Reduce length of hospital stay

Lower wound infection rate (no mediastinitis)

Lower risk for pneumonia (ambulate earlier, cough better with less pain)

Reduced trauma / less pain

Less blood loss/decreased blood transfusion

Better and direct visualization of valves for better repair and replacement (better visualization than from sternotomy)

No difference in morbidity and mortality

# MICS

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## Indications:

Mitral Valve Repair and Replacement

Tricuspid Valve Repair and Replacement

Atrial Septal Defect and patent ductus ovale

Atrial Myxoma

Atrial Fibrillation / MAZE and Left Atrial Appendage  
Ligation

Aortic Valve Repair and Replacement

Double valve (MVR+TVR, MVR+AVR)

LVAD (Lateral Trial – Heartware @ Jewish)

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# The Operation

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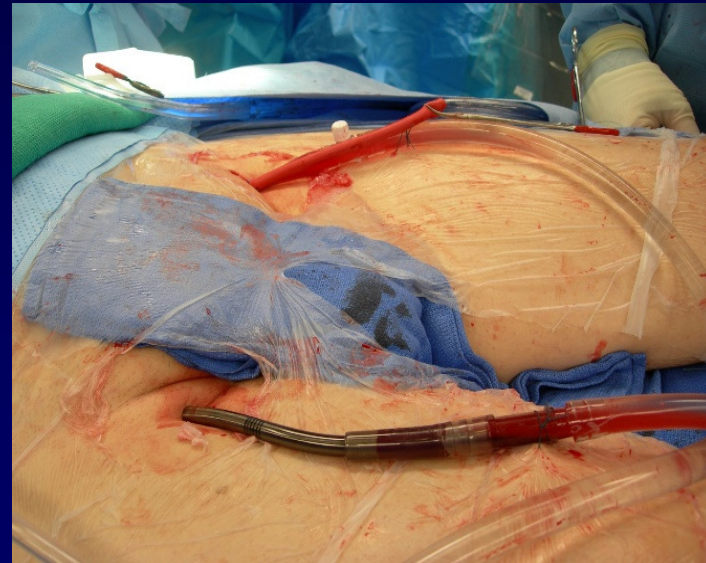


# CPB Cannulation

- Femoral Arterial and Femoral Venous (primary strategy)
- Axillary/Subclavian Arterial and Femoral Vein



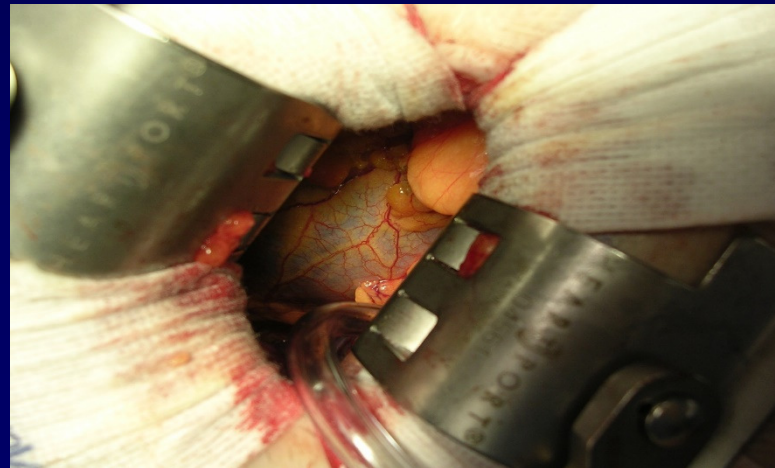
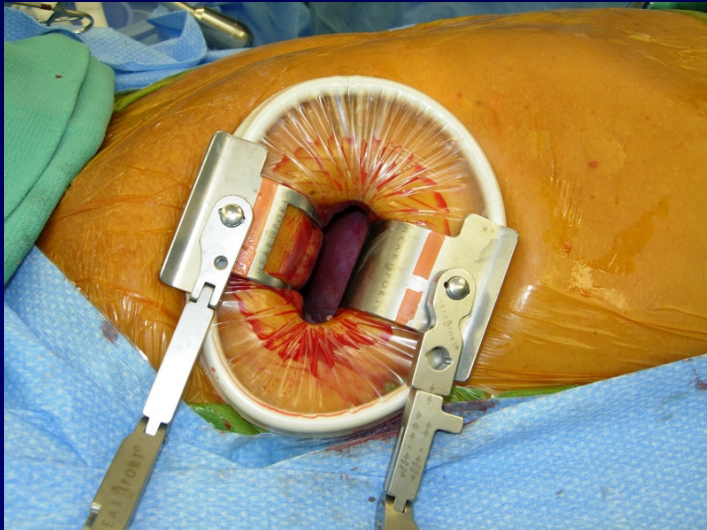
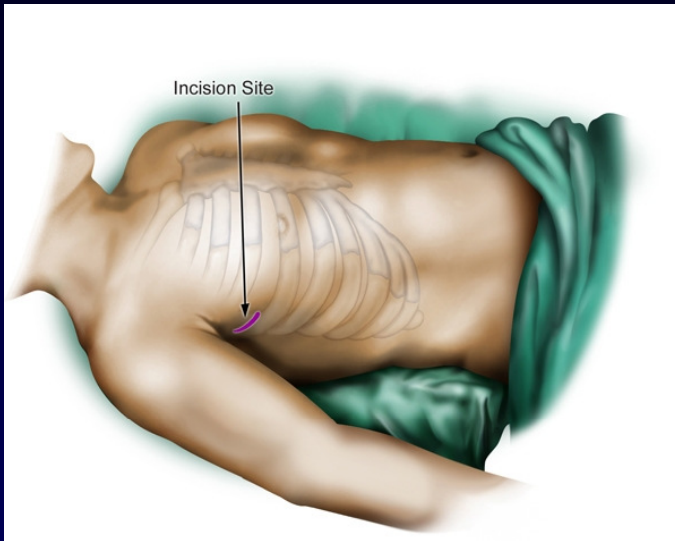
Cut down



Percutaneously – Seldinger w/ Perc close device

# Right mini-thoracotomy for MVR, TVR, PFO, ASD, Myxoma, Maze

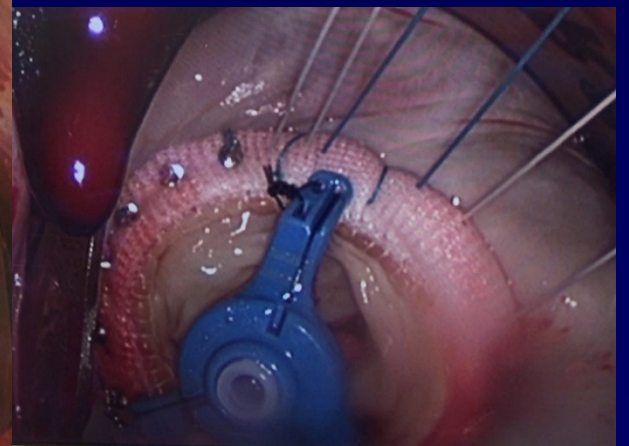
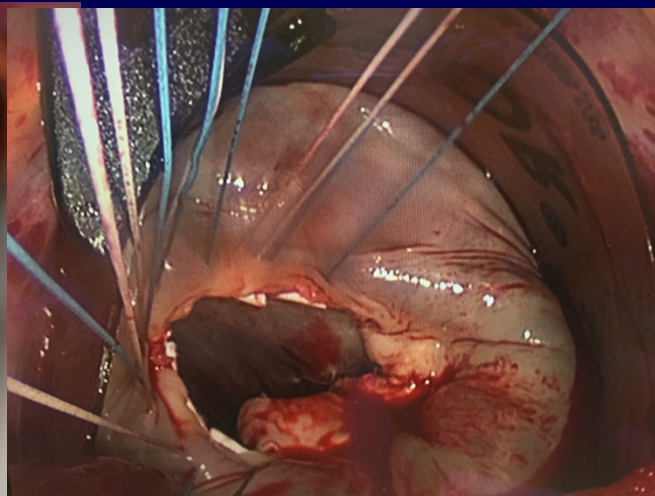
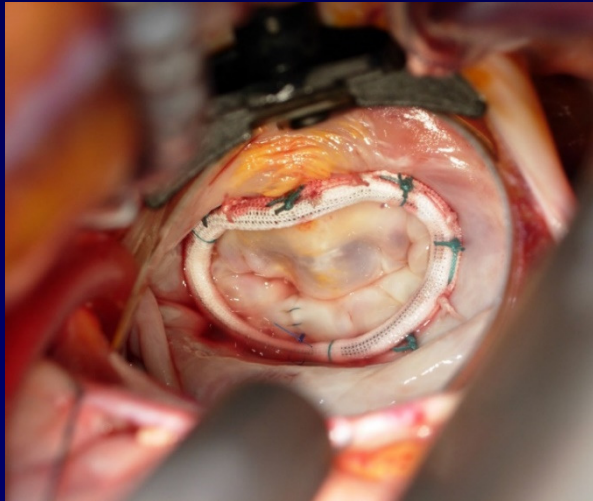
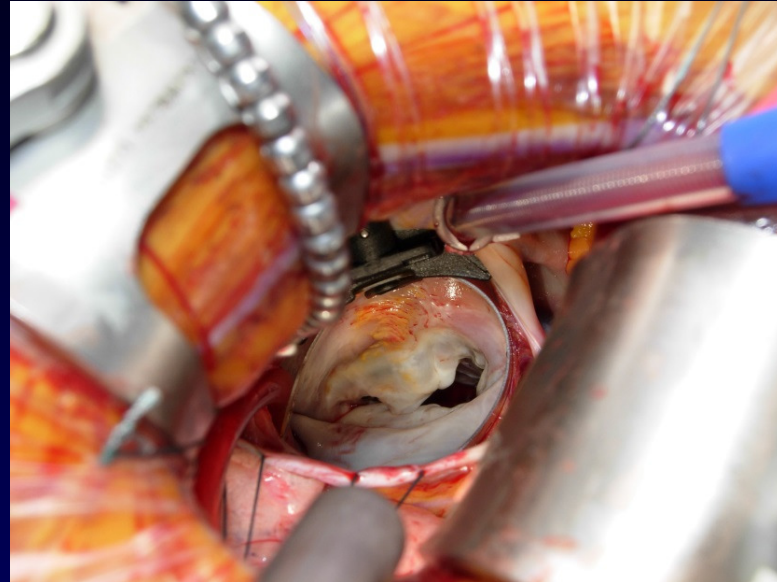
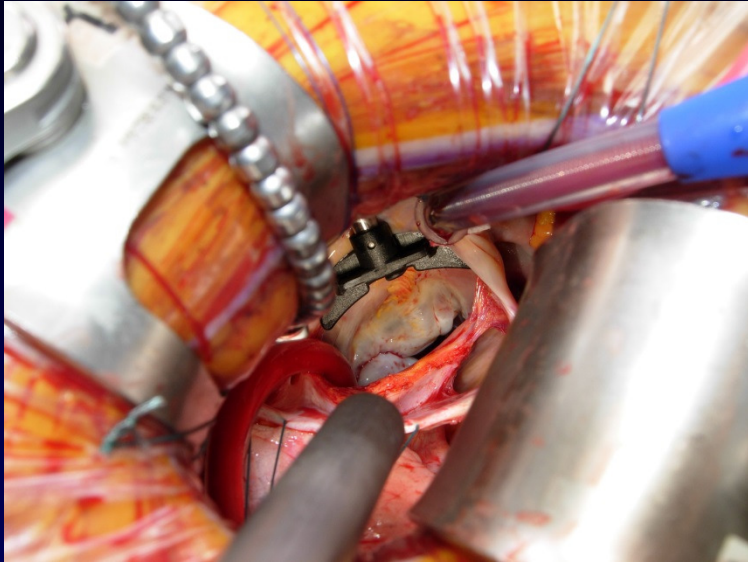
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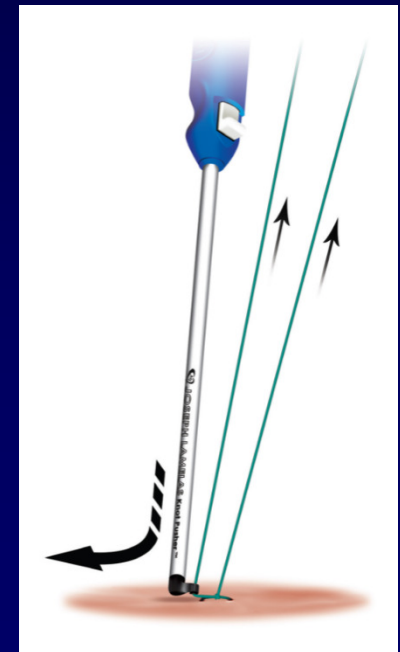
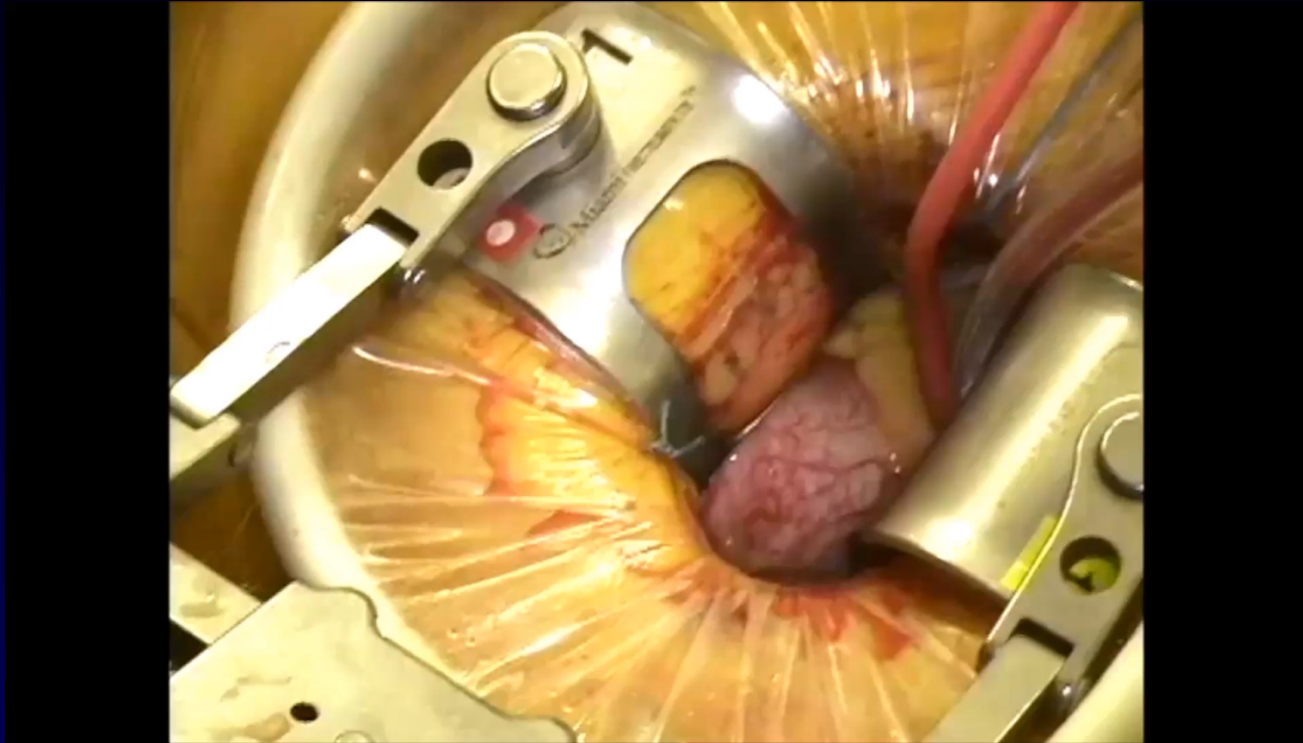




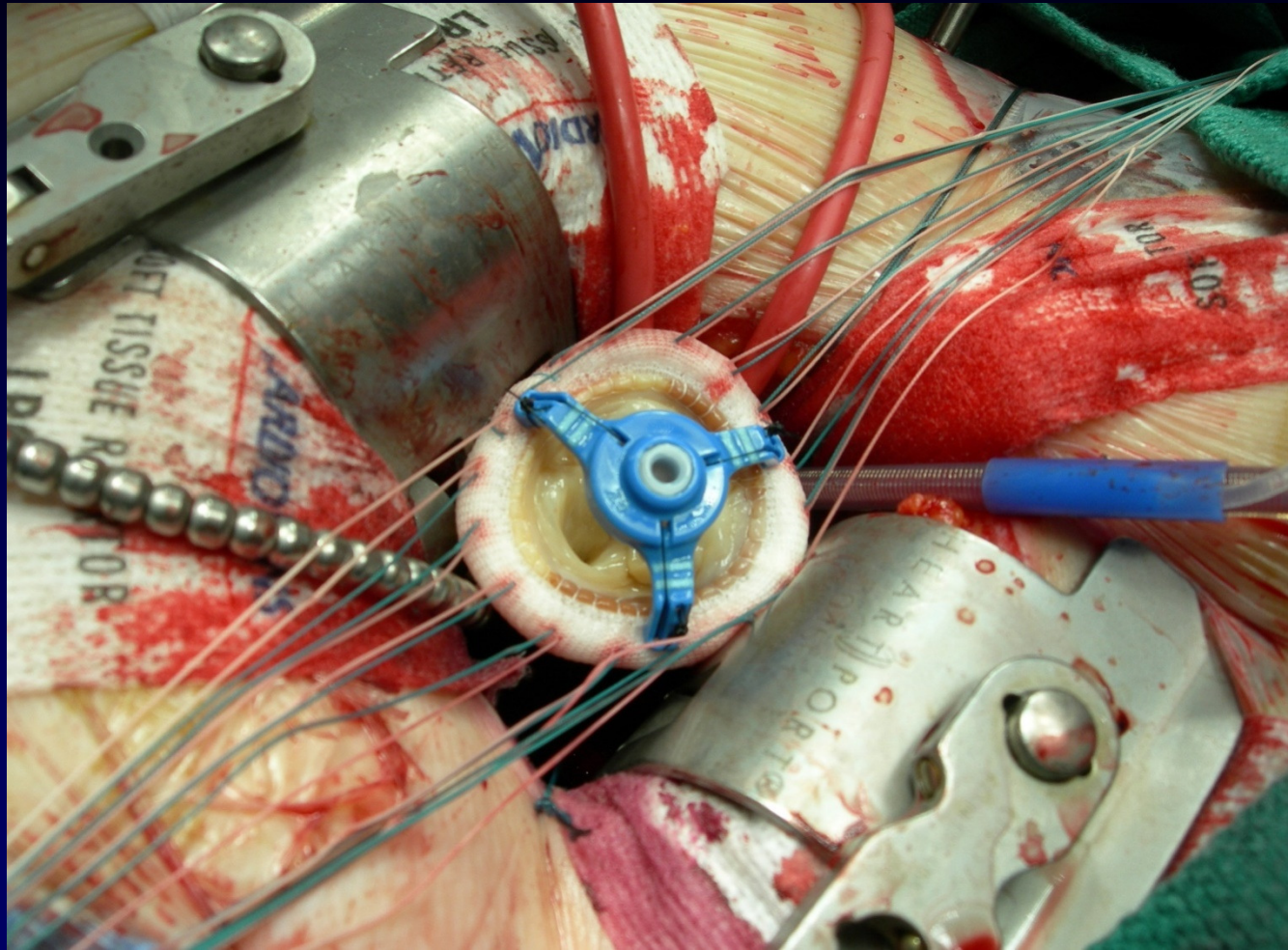
# Mitral valve repair and replacement

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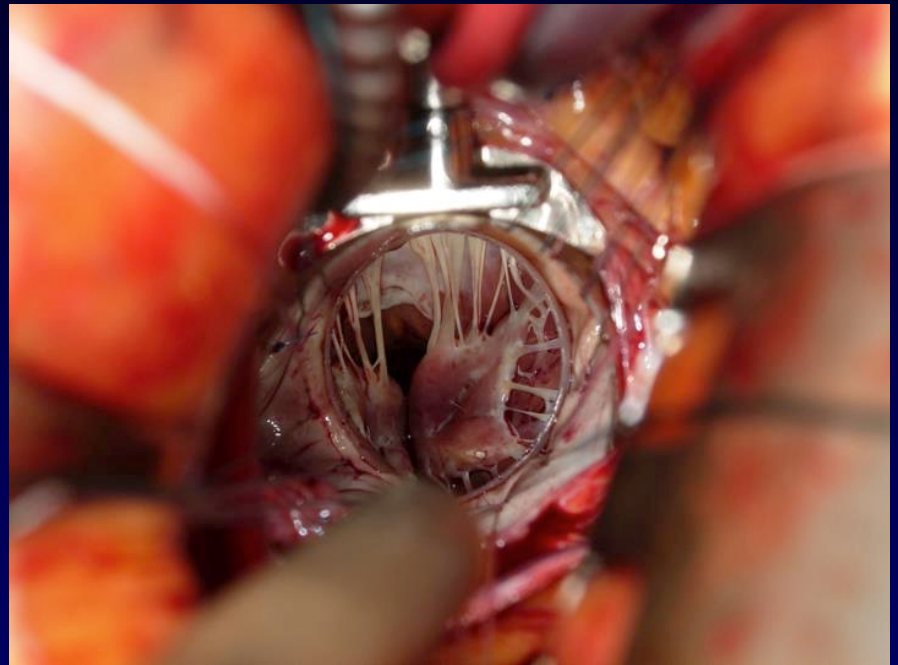
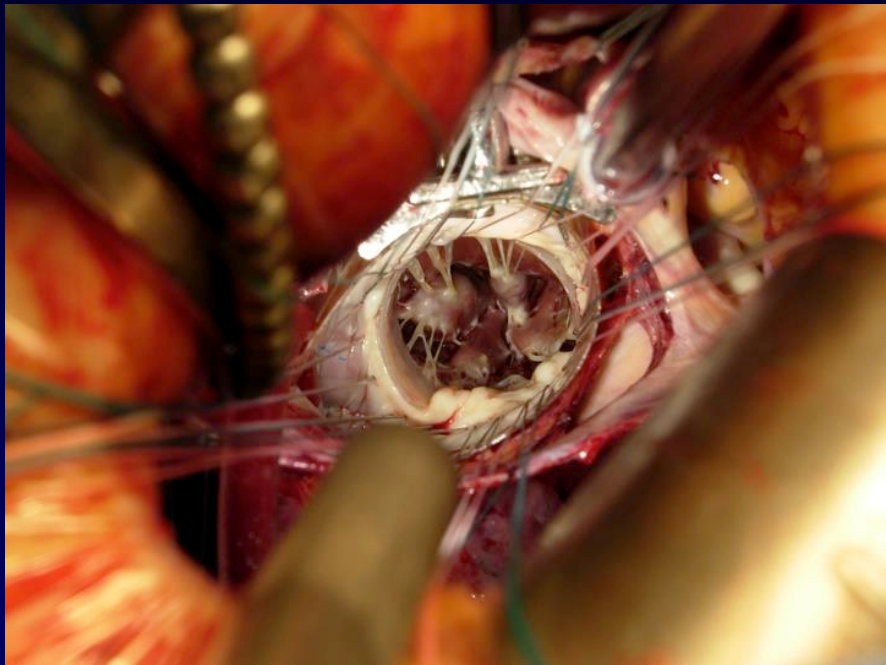






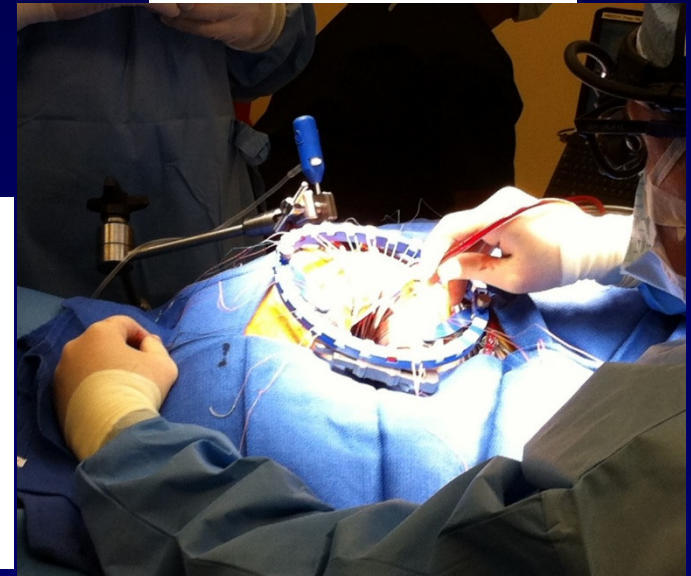
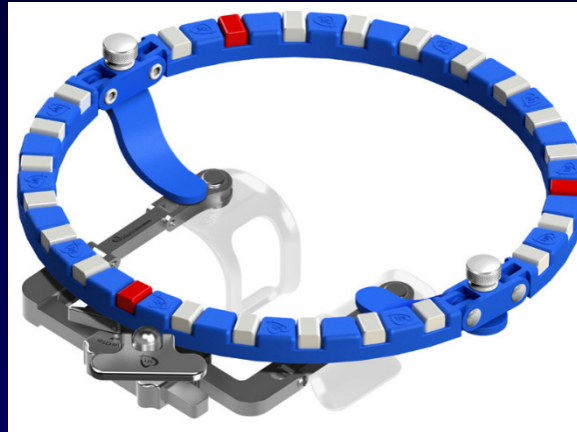
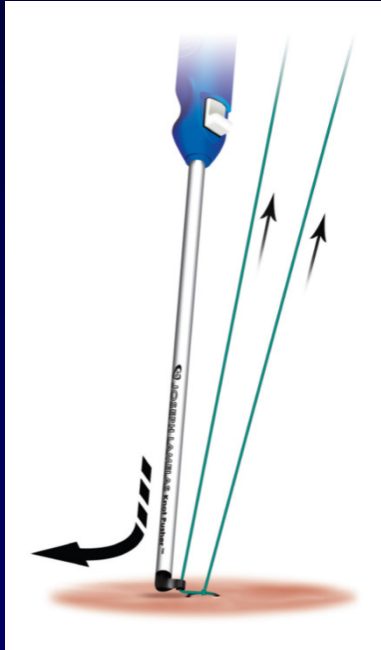
# Great visualization of the subvalvular apparatus for mitral valve repair

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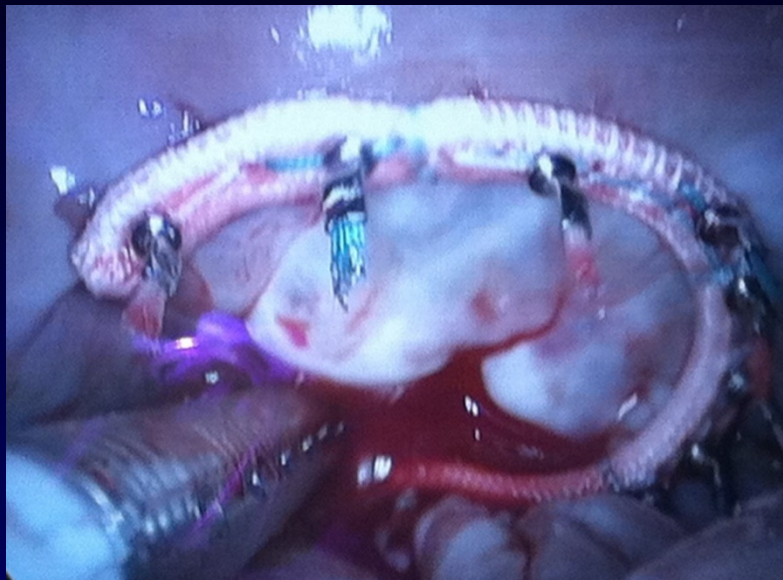


# MIS Specialized Instruments

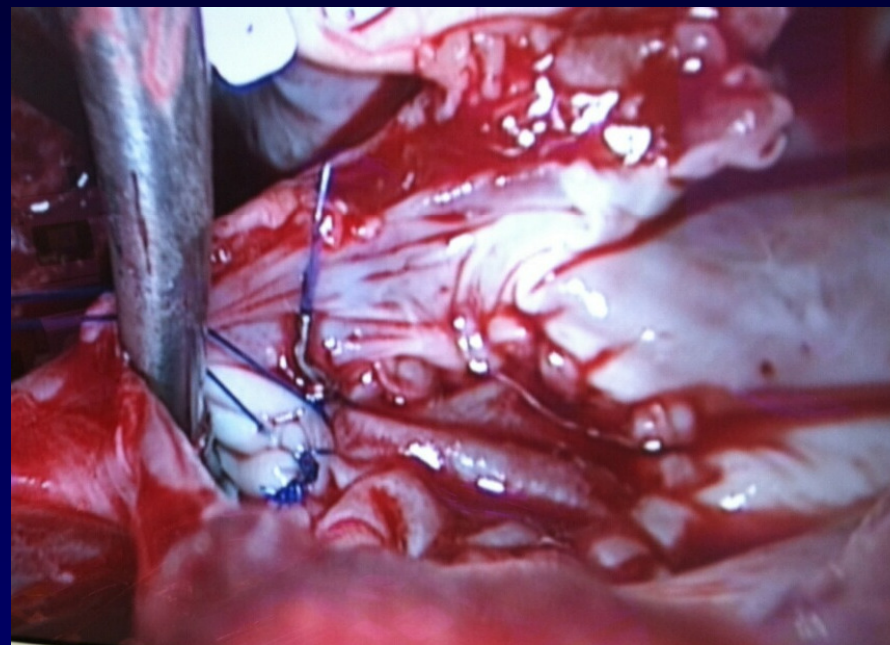


# Tricuspid Repair, ASD closure, Myxoma

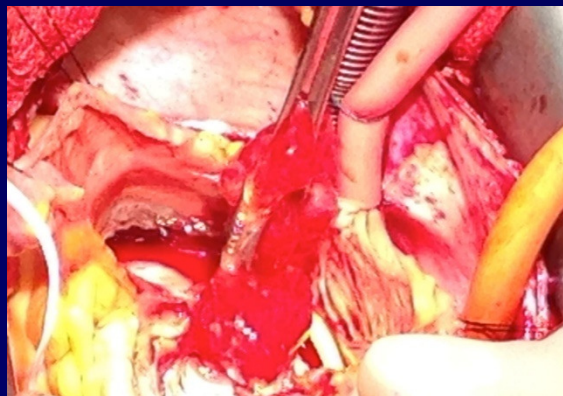
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Tricuspid Repair



Sinus Venosus ASD



Myxoma



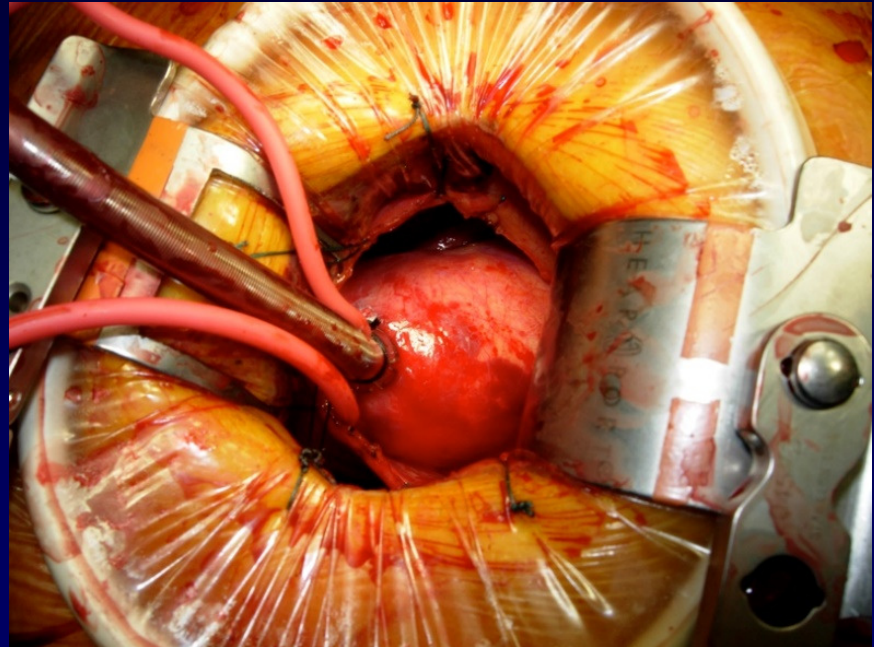
# Small incision for MVR, TVR, PFO, ASD, Maze

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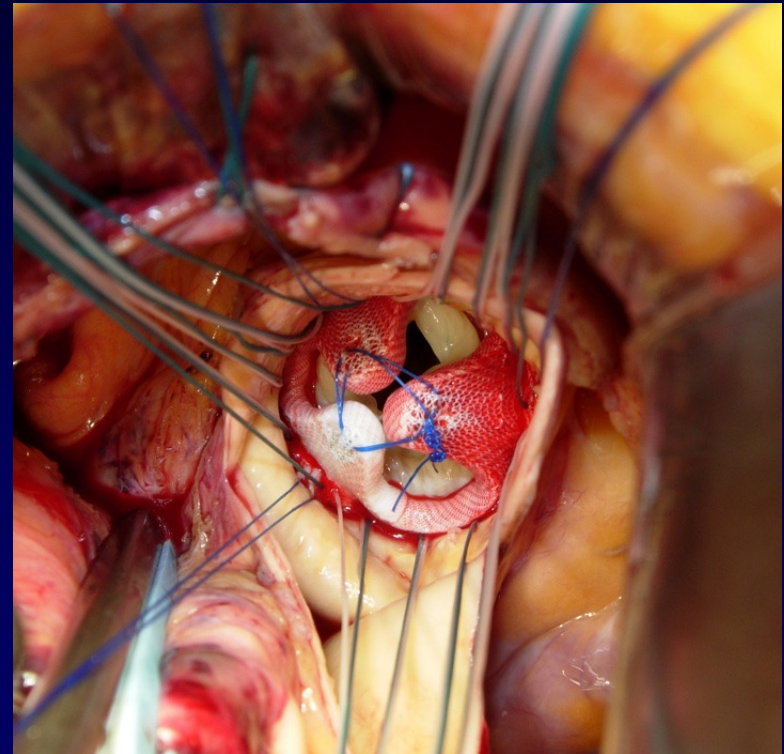
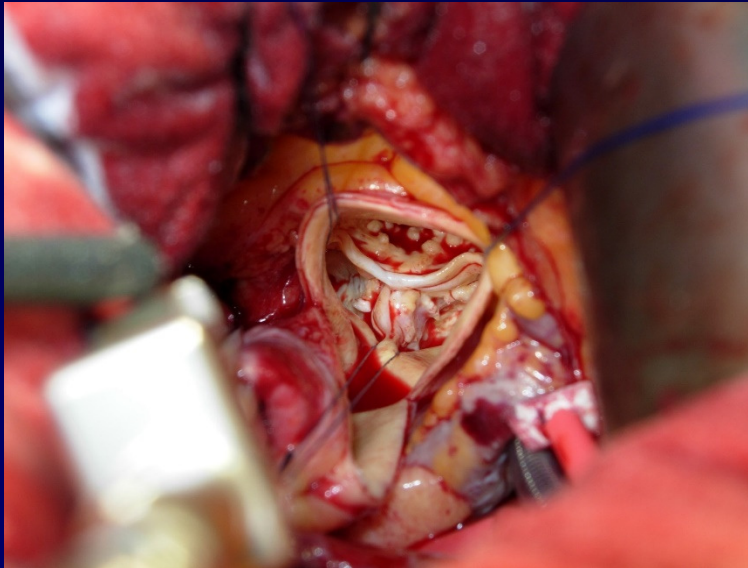
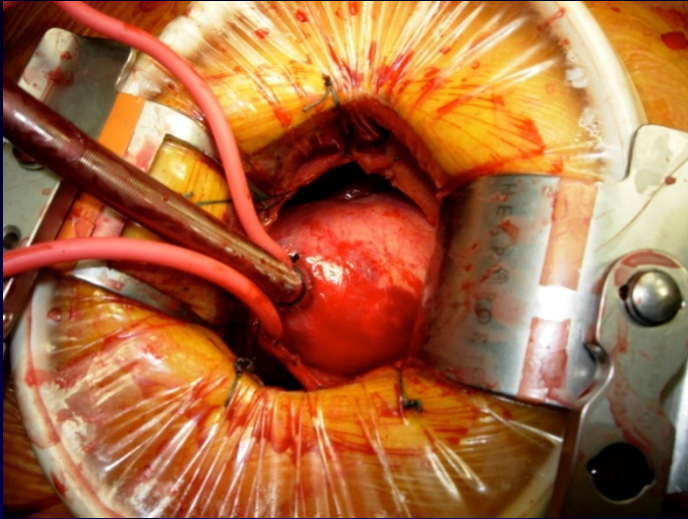
# Aortic Valve Replacement

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# Aortic Valve Replacement

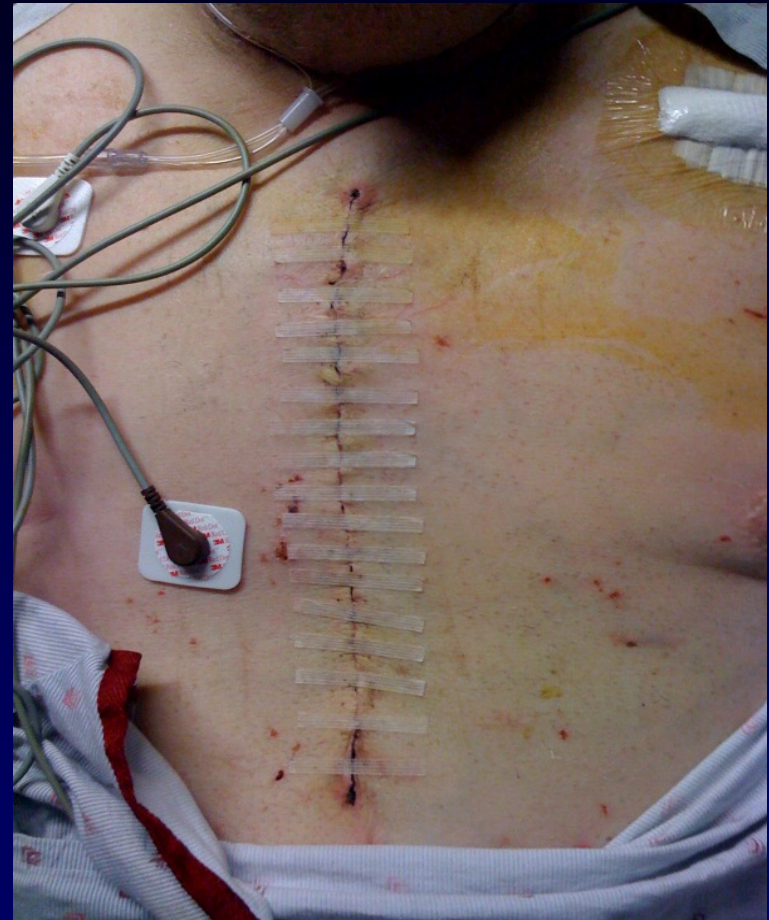
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# Small Incision for Aortic Valve Replacement

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Other minimally invasive cardiac surgery:

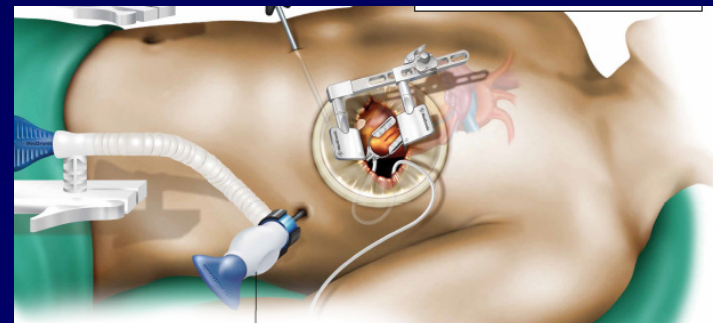
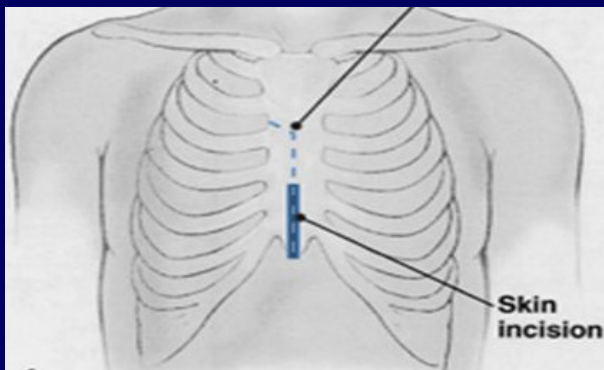
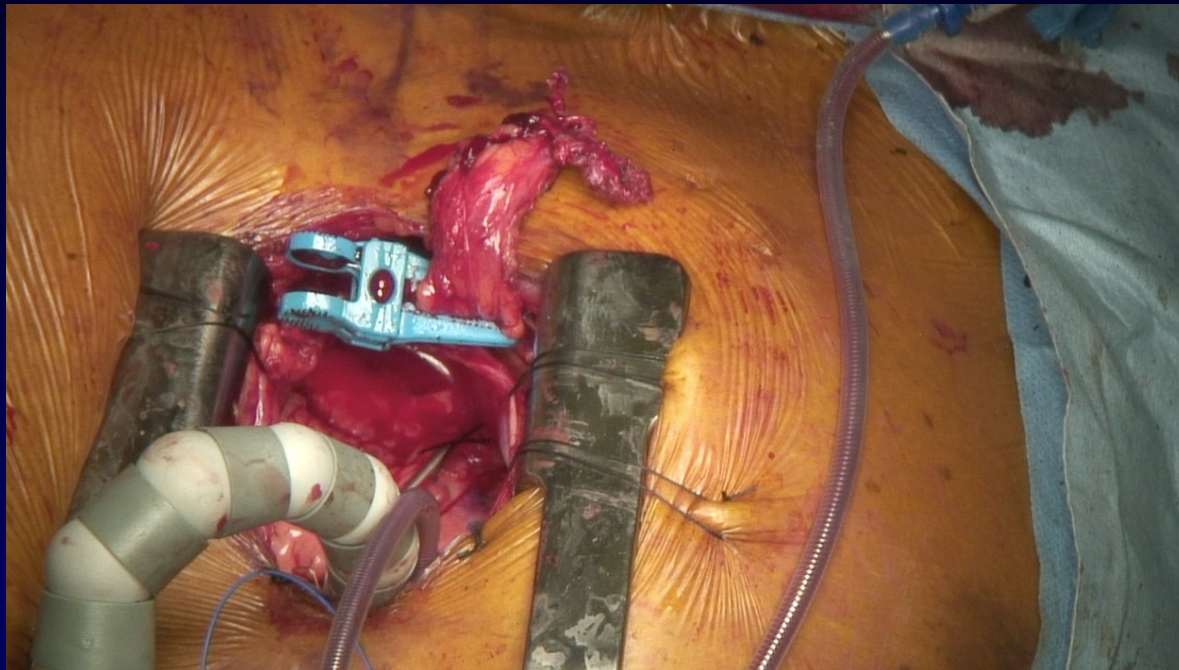
MIDCAB

Mini- Maze

MIS LVAD placement

# MICAB – Off-pump Minimally Invasive Coronary Bypass Surgery $\pm$ Hybrid Procedure

Hemi-sternotomy



# Mini Maze and Left Atrial Ligation

## Consensus Recommendation of Societies

### 2016 Consensus Statement on Surgical AF:

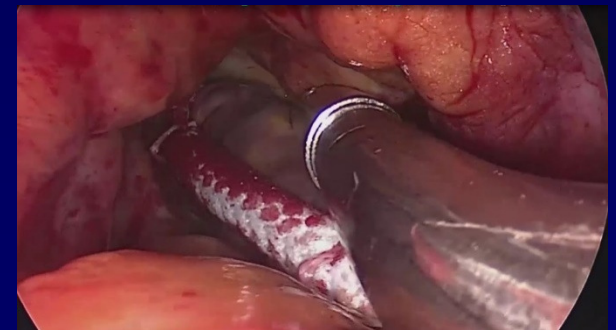
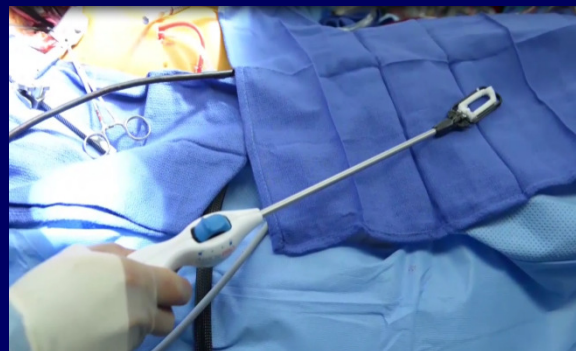
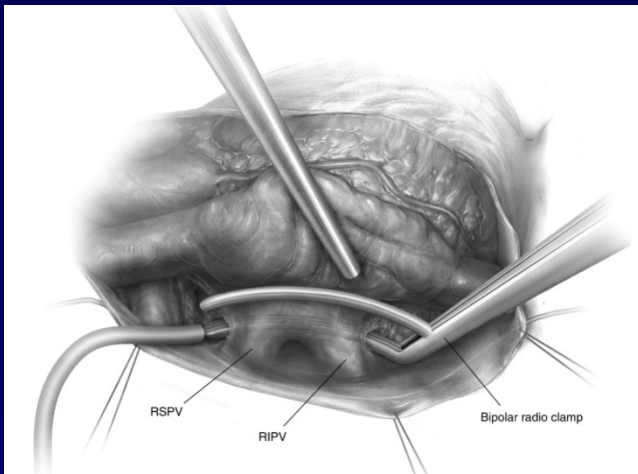
*“It is advisable that all patients with documented AF referred for other cardiac surgeries undergo a left or biatrial procedure for AF, unless it will add significant risk.”*

Heart Rhythm Society  
American College of Cardiology  
American Heart Association  
Society of Thoracic Surgeons  
European Heart Rhythm Association  
European Cardiac Arrhythmia Society

# Mini Maze and Left Atrial Ligation



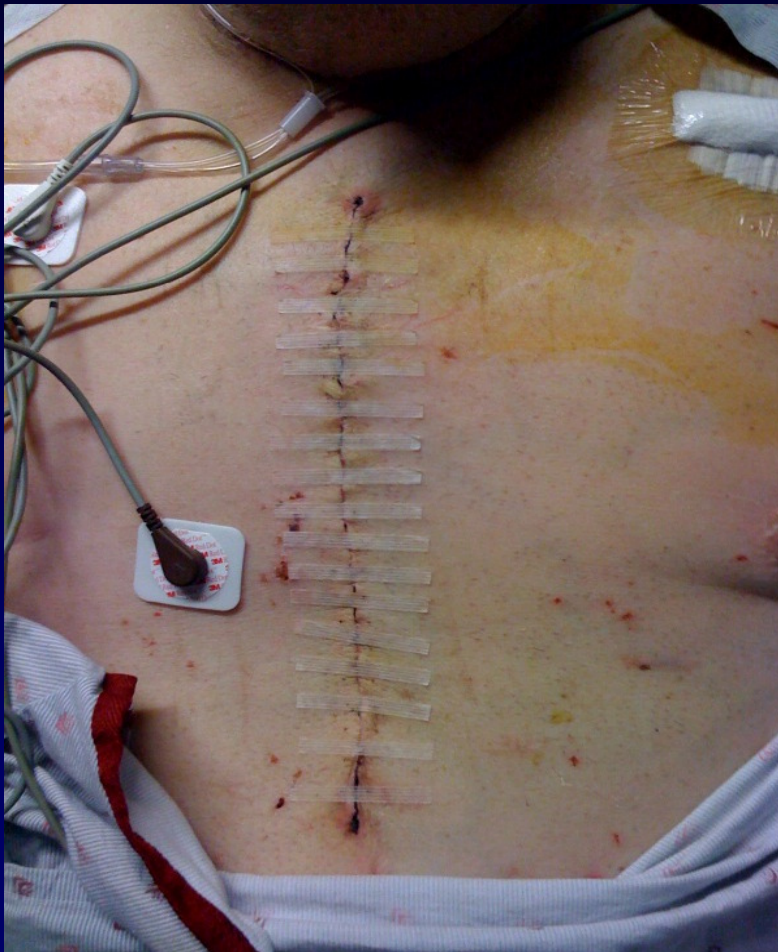
Cryo + RF



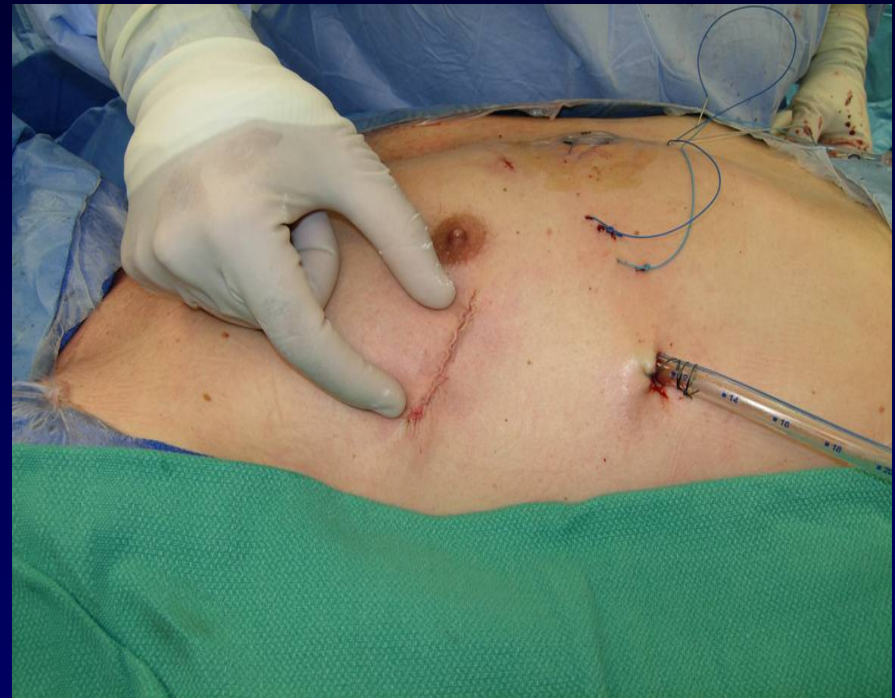


# Which incision do you prefer?

Sternotomy



MIS





Thank you

