



# History of Mitral Valve Surgery and Repair

Tirone E. David



# The First Recorded MV Operation

Boston Medical and Surgical Journal  
June 28, 1923. Vol 188:1023-7.



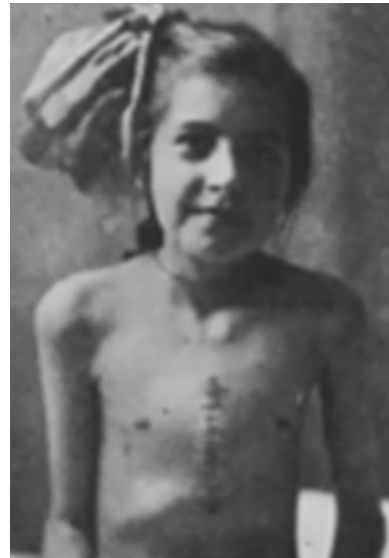
The NEW ENGLAND  
JOURNAL of MEDICINE

## Cardiotomy and Valvulotomy for Mitral Stenosis; Experimental Observations and Clinical Notes Concerning an Operated Case with Recovery

ELLIOTT C. CUTLER, M.D., and S. A. LEVINE, M.D.



Claude Beck, Elliot Cutler, Samuel Levine



**11 year-old patient**

**1<sup>st</sup> successful closed mitral valvotomy  
for mitral stenosis**

**The patient survived 4.5 years  
Died of pneumonia**



# Closed Mitral Commissurotomy for Mitral Stenosis

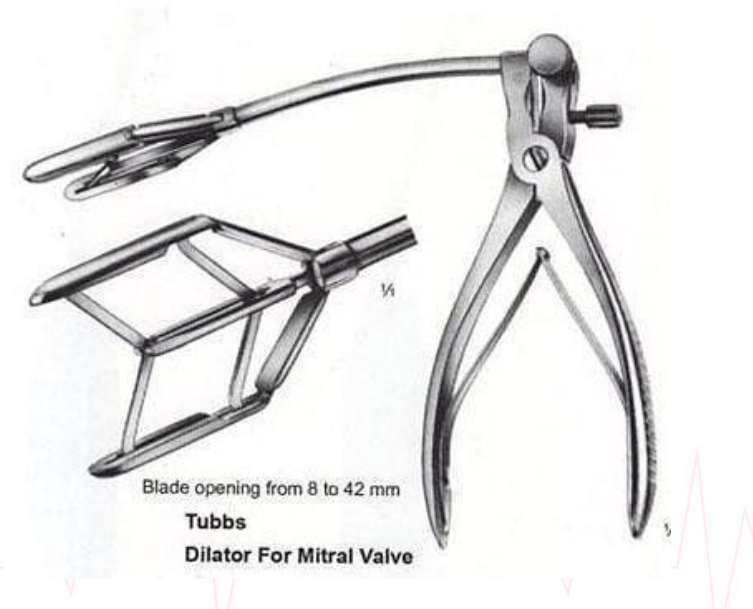
1923 – Elliot Cutler and Levine - Digital commissurotomy

1925 – Sir Henry Souttar – Digital commissurotomy

.....

1948 – 1962: several reports on closed mitral commissurotomy

1962 – Oswald Tubbs – **Trans-ventricular valve dilator**



# Annuloplasty for Mitral Regurgitation

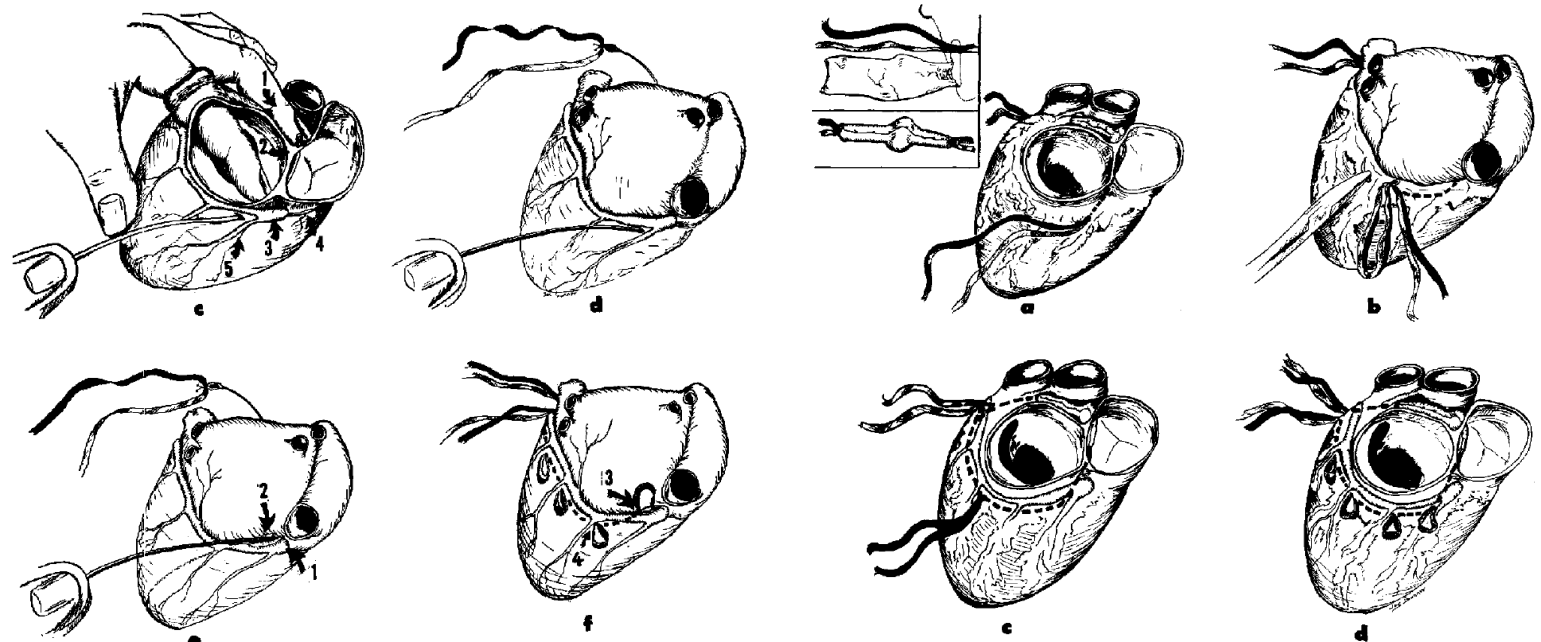
Pericardial sleeve - Am J Cardiol 1958;2:267-275

58 patients: 25 in CHF: operative mortality 54%

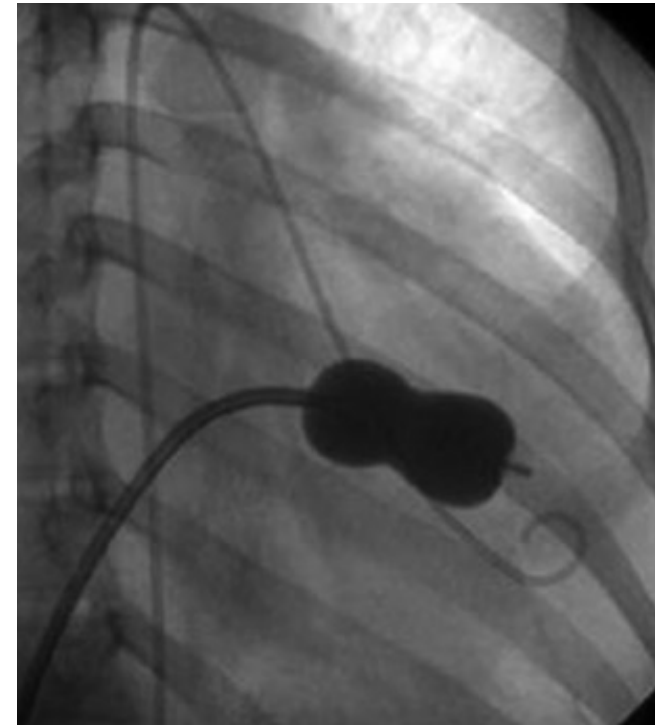
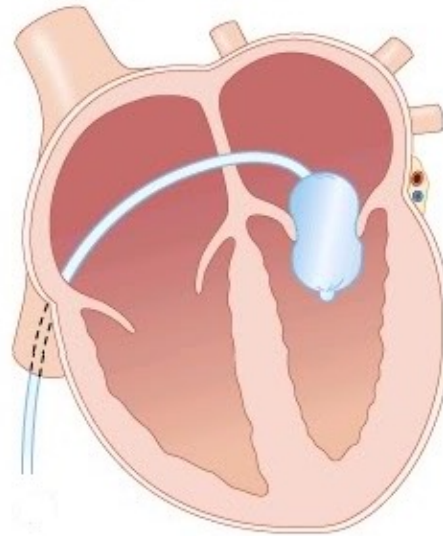
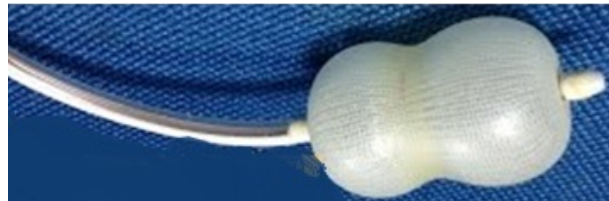
35 stable: operative mortality 17%



Julio C. Davila  
1932 - 2016

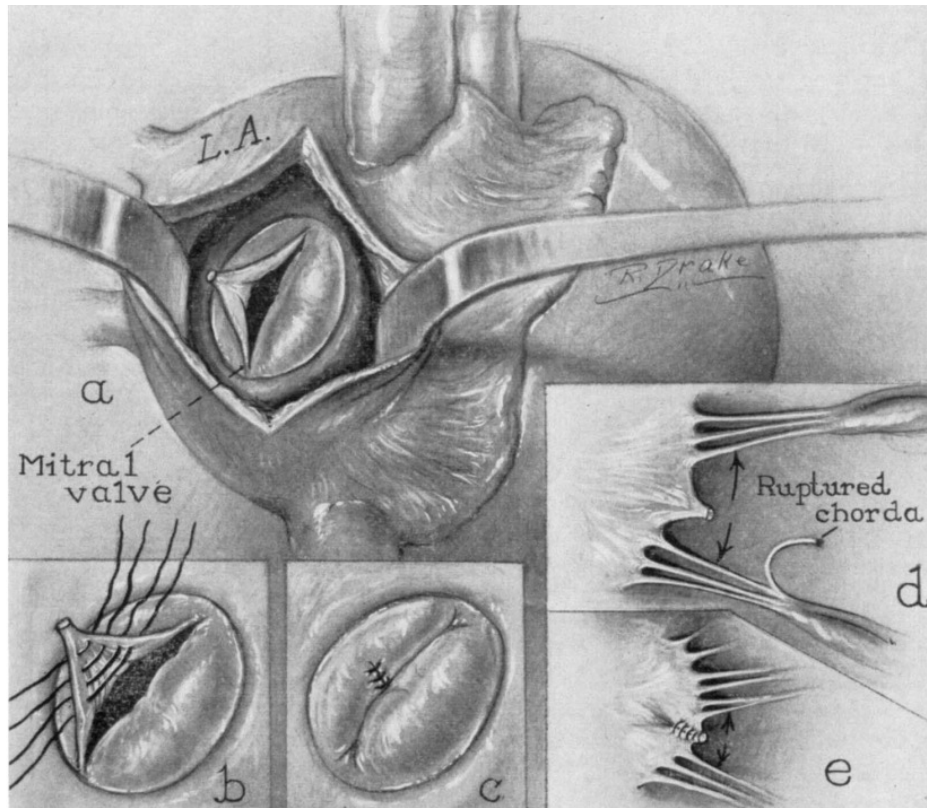


# Inoue Balloon Valvotomy for Mitral Stenosis



Inoue K et al. J Thorac Cardiovasc Surg 1984;87:394-402

# Open Surgical Correction of Mitral Regurgitation



McGoon DC  
J Thorac Cardiovasc Surg 1960;39:357-362

50<sup>th</sup> Annual Meeting of The American Association for Thoracic Surgery, Washington, DC, April 6-8, 1970.

Volume 61, Number 1

January 1971

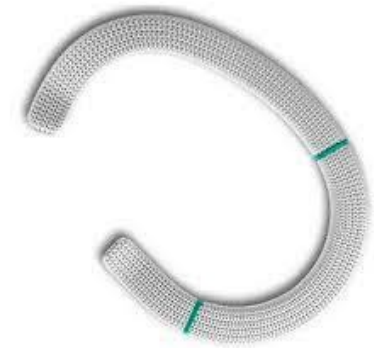
The Journal of **THORACIC AND  
CARDIOVASCULAR SURGERY**


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A new reconstructive operation for  
correction of mitral and tricuspid  
insufficiency

*A. Carpentier, M.D. (by invitation), A. Deloche, M.D. (by invitation),  
J. Dauptain, M.D. (by invitation), R. Soyer, M.D. (by invitation),  
P. Blondeau, M.D. (by invitation), A. Piwnica, M.D. (by invitation),  
and Ch. Dubost, M.D. (by invitation). Paris, France*

*Sponsored by D. C. McGoon, M.D., Rochester, Minn.*





63<sup>rd</sup> Annual Meeting of The American Association for Thoracic Surgery, Atlanta, Ga, April 25-27, 1983

*Volume 86, Number 3*

*September 1983*

*The Journal of* **THORACIC AND  
CARDIOVASCULAR SURGERY**

J THORAC CARDIOVASC SURG 86:323-337, 1983

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*Honored Guest's Address*

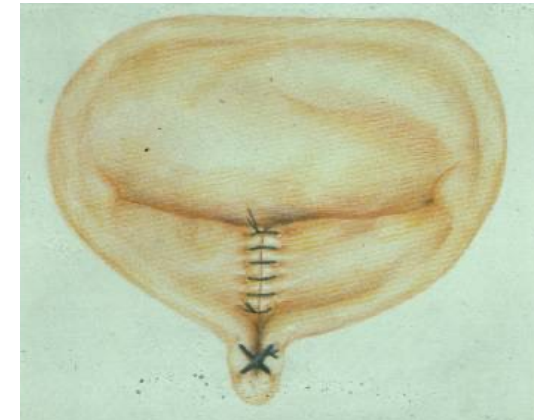
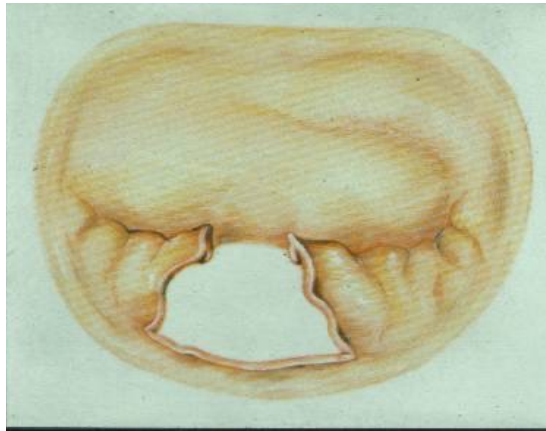
Cardiac valve surgery—the “French correction”

Alain Carpentier, M.D., *Paris, France*



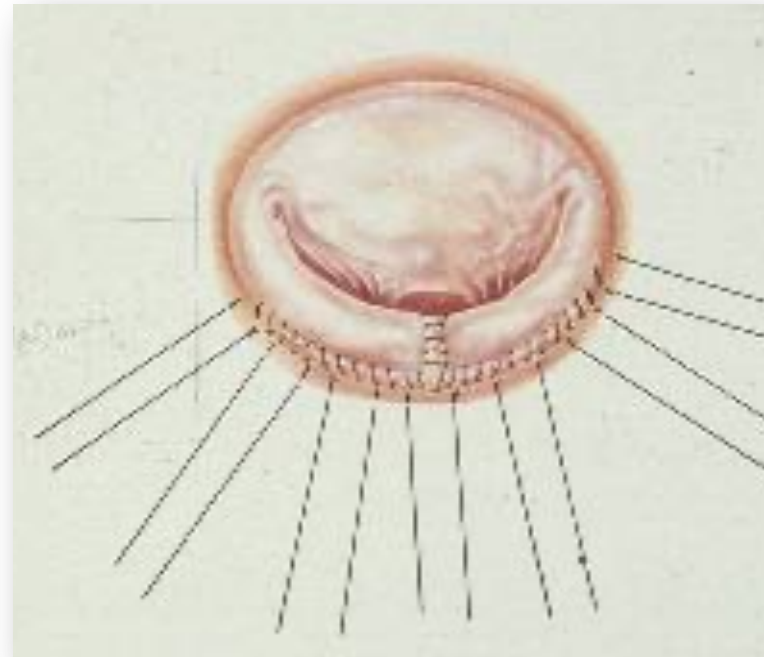
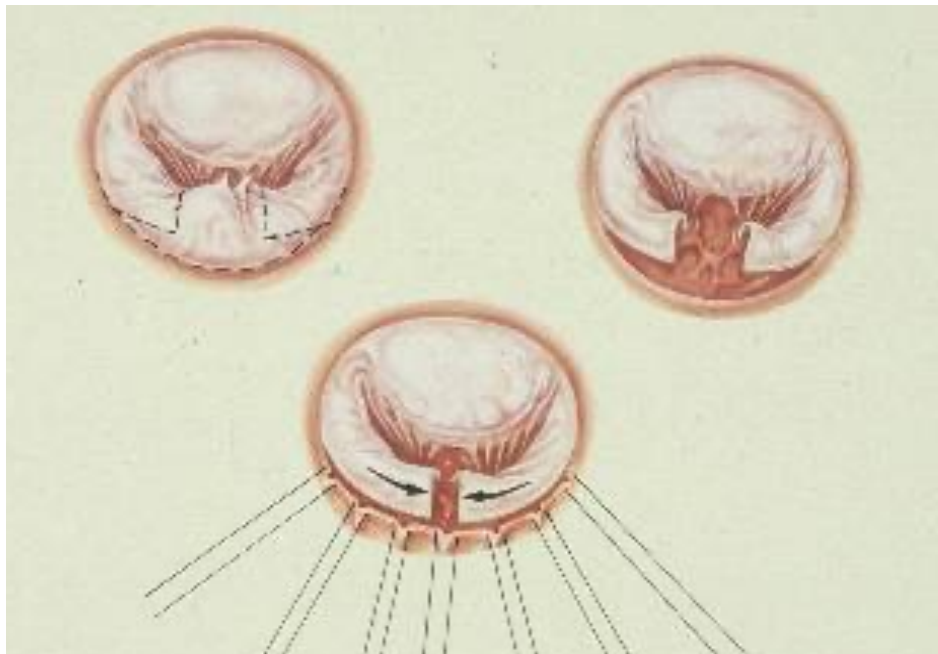


# Carpentier's Techniques



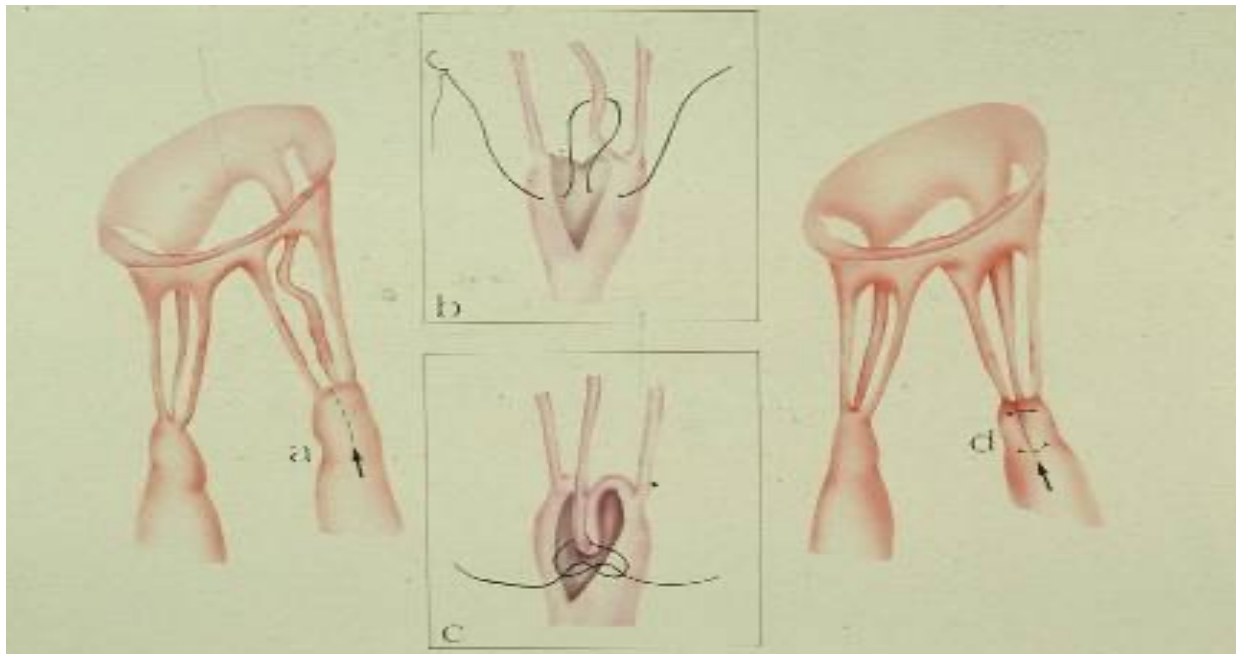
Partial resection of the posterior leaflet with plication of annulus

# Carpentier's Techniques

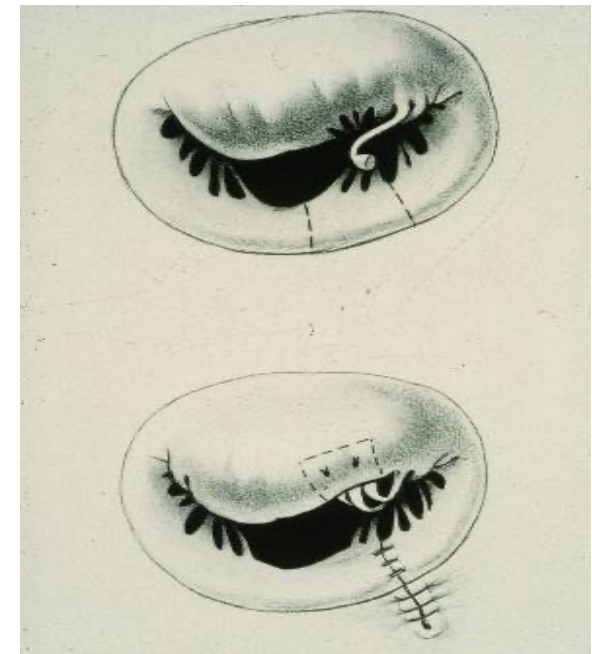


Partial resection of posterior leaflet with sliding plasty

# Carpentier's Techniques



Chordal shortening

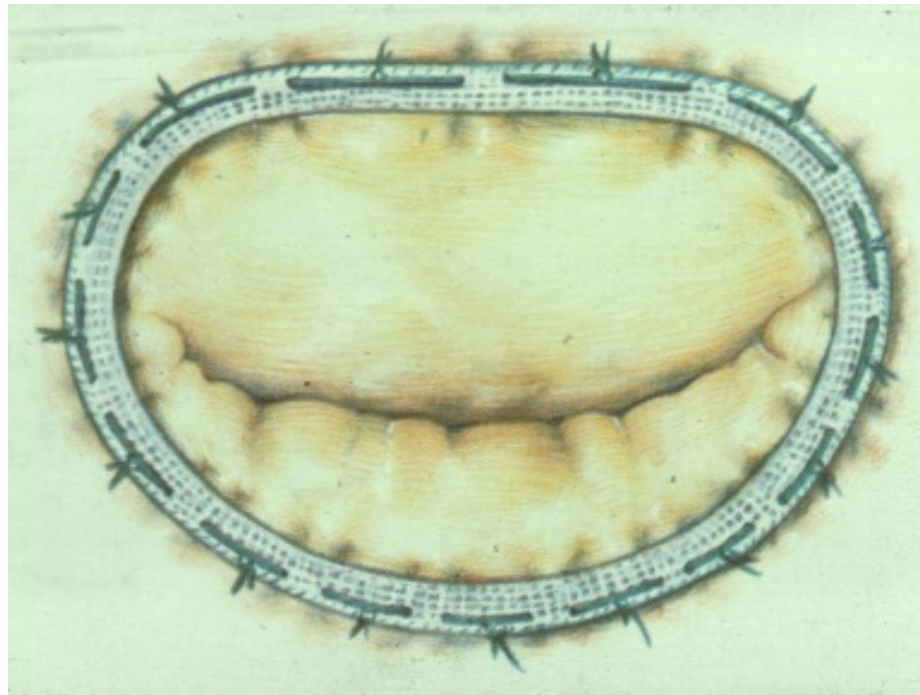


Chordal transfer



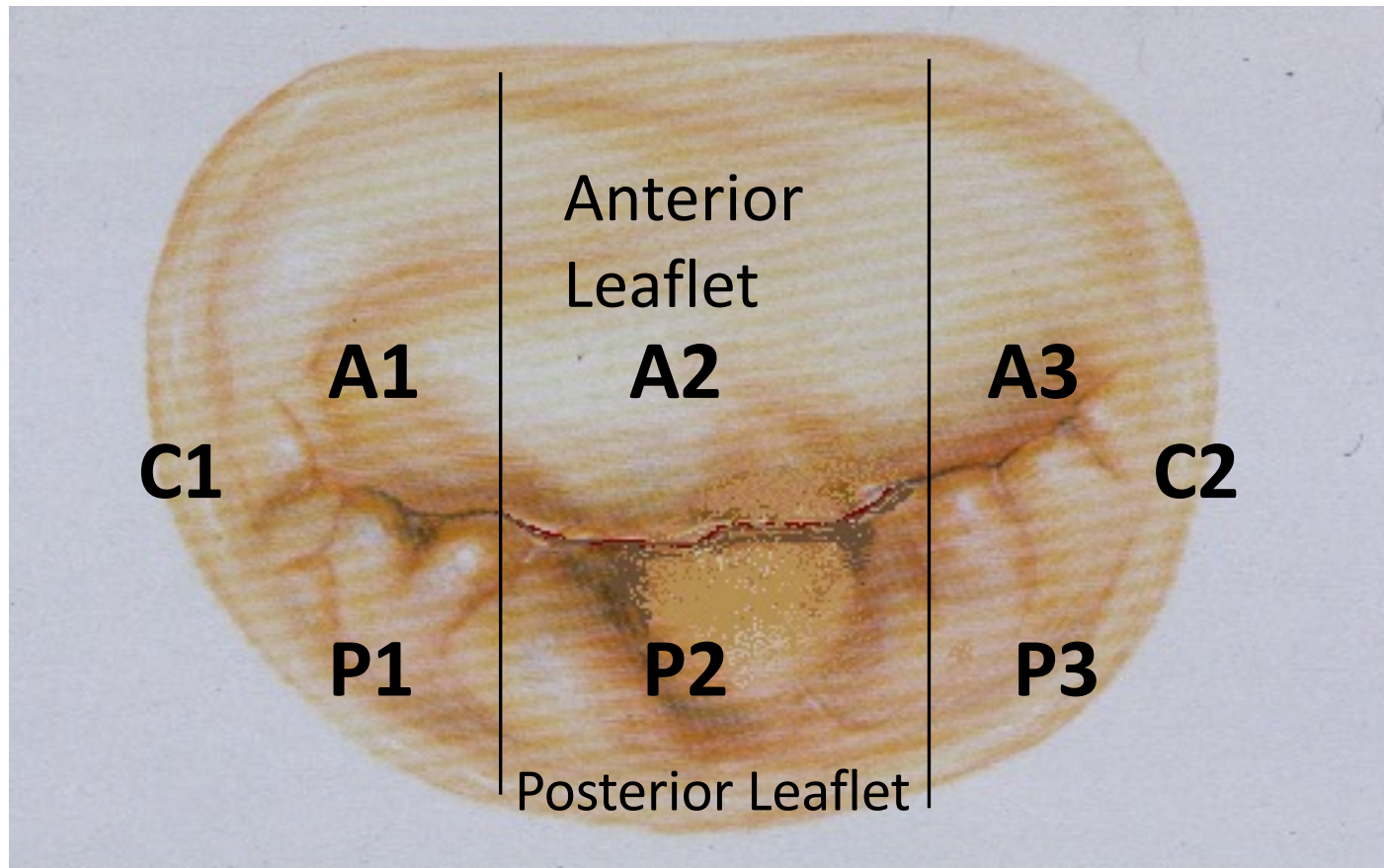
# Carpentier's Techniques

Remodeling of the mitral annulus with a rigid ring



# Mitral Valve Segments

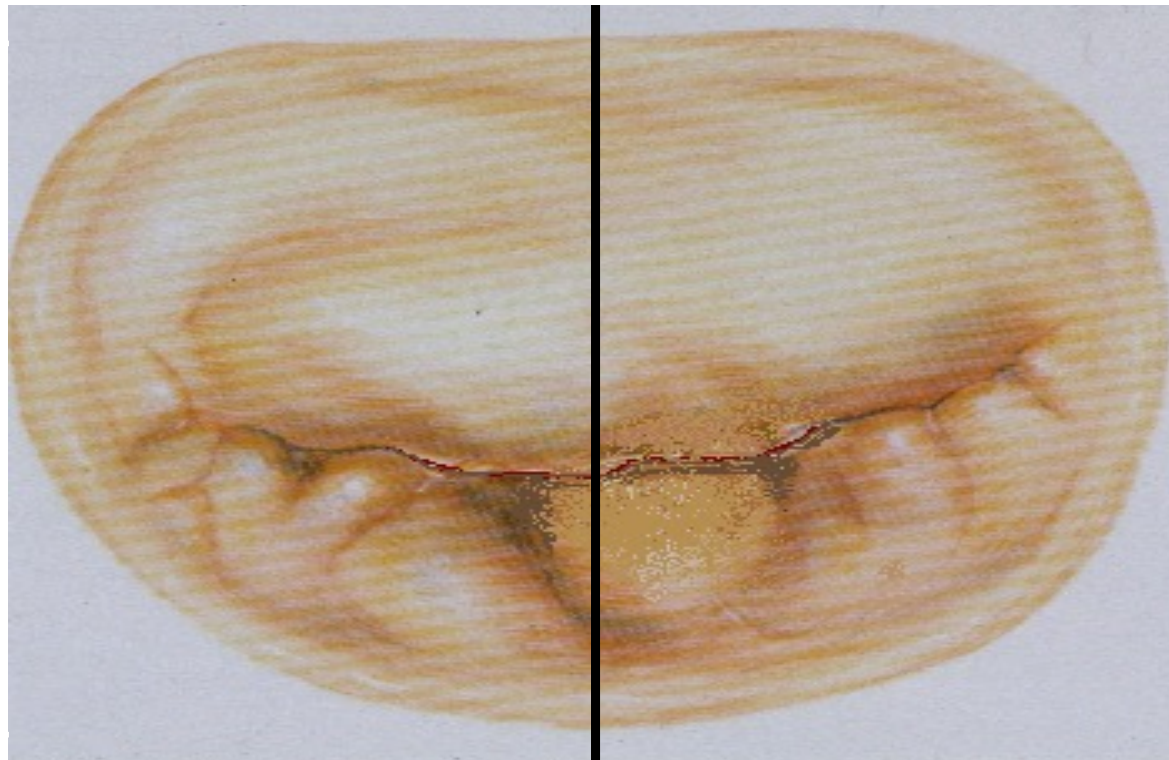
## Carpentier's classification



# Functional Anatomy of the MV

## Mid-Mitral Line

APM



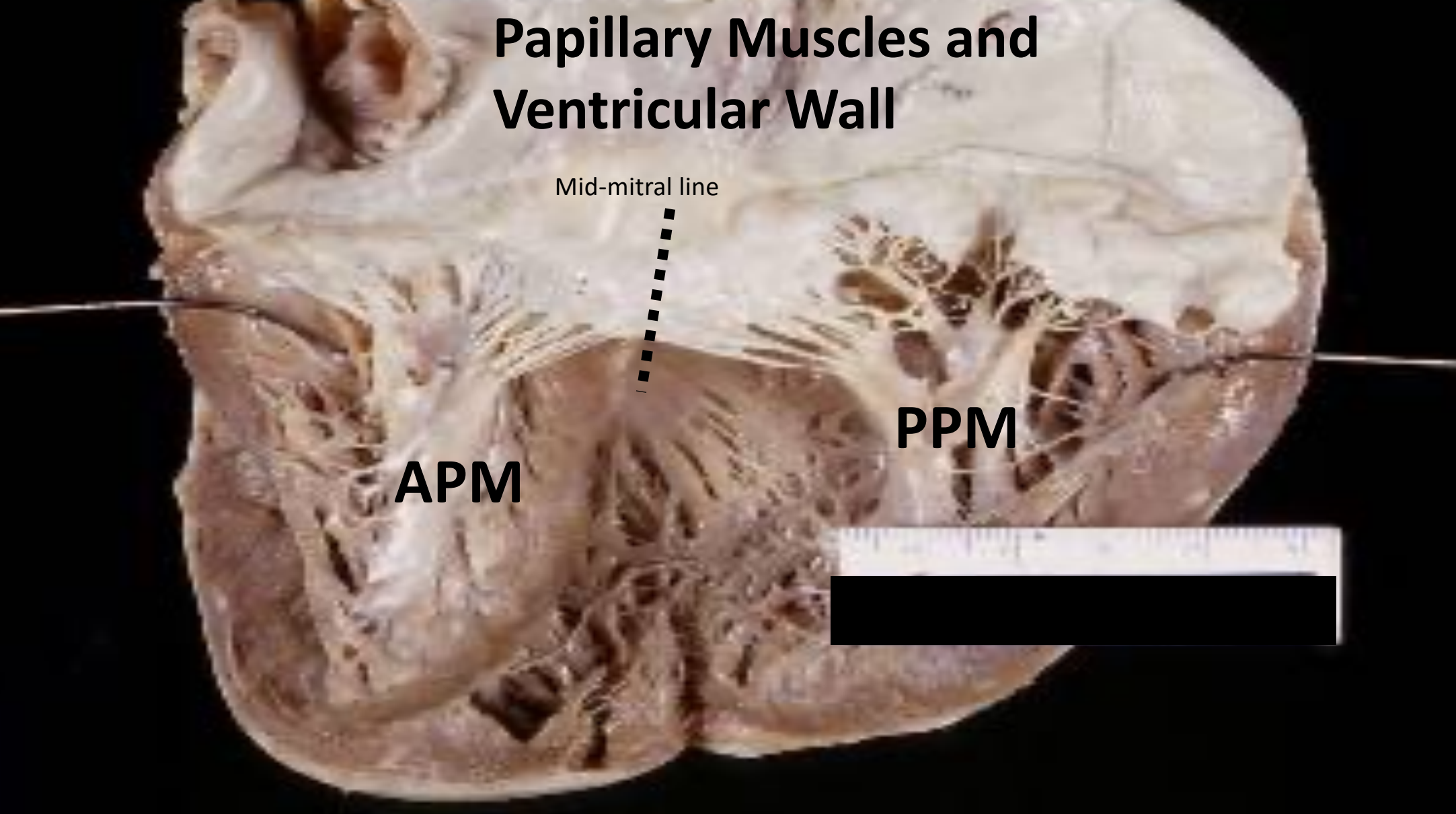
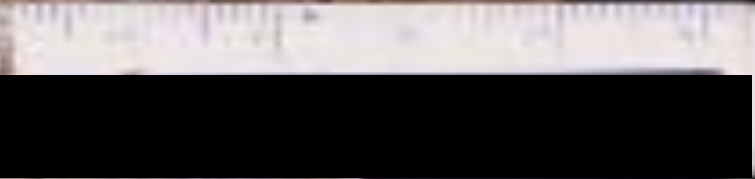
PPM

# Papillary Muscles and Ventricular Wall

Mid-mitral line

APM

PPM



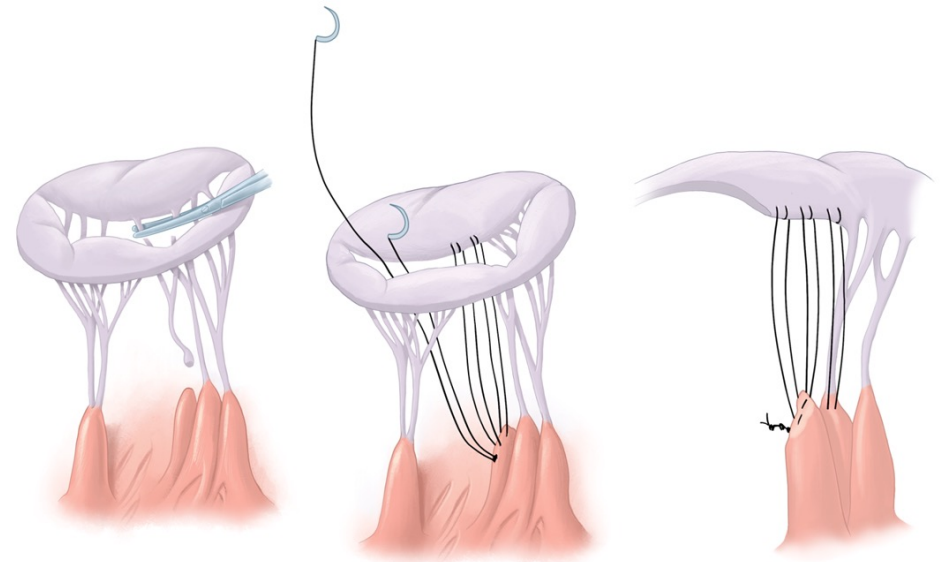
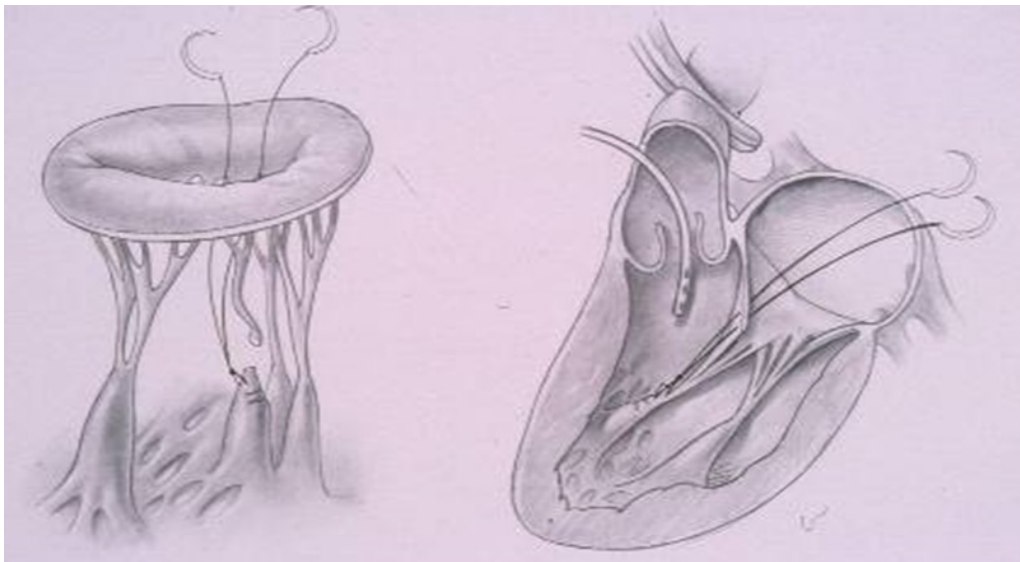


# MV Repair Beyond Carpentier's Techniques





# Repair of Leaflet Prolapse with Gore-Tex Sutures

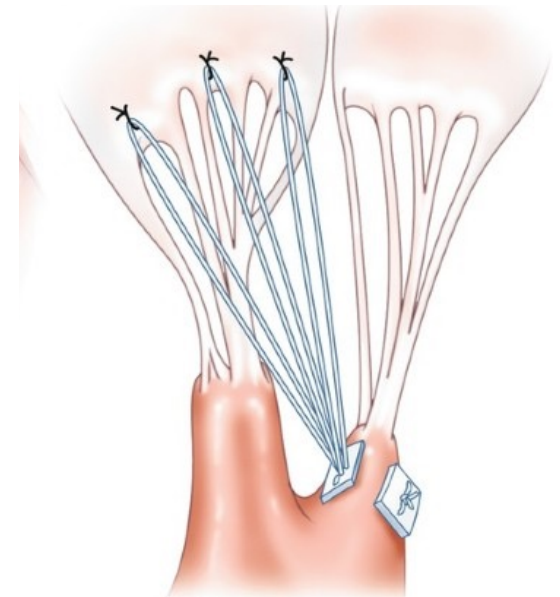
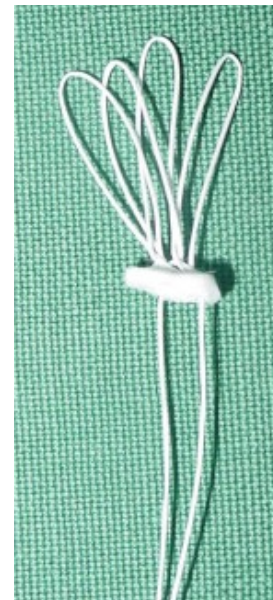
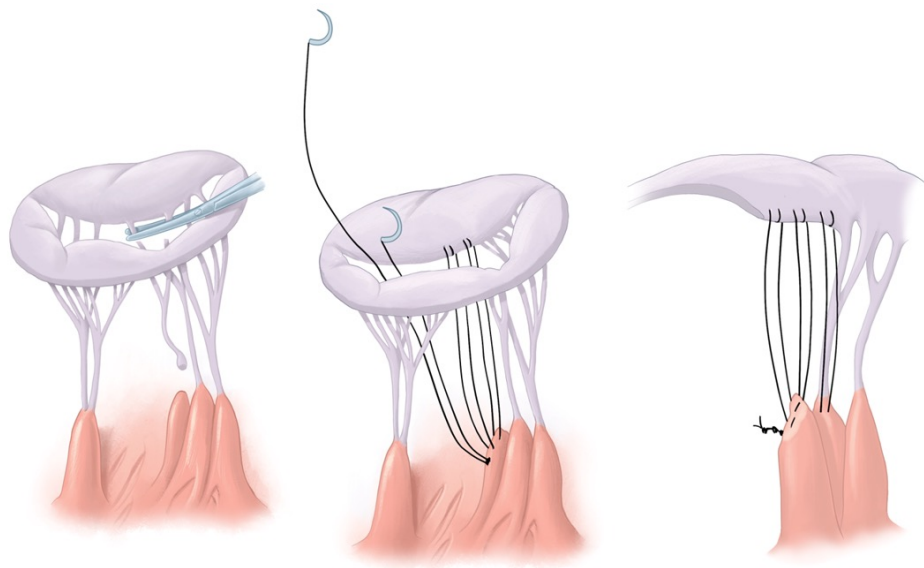


David TE: J Card Surg 1989;4:286-90

David TE: J Thorac Cardiovasc Surg 1998;115:1279-85



# Chordal Replacement with Gore-Tex Sutures

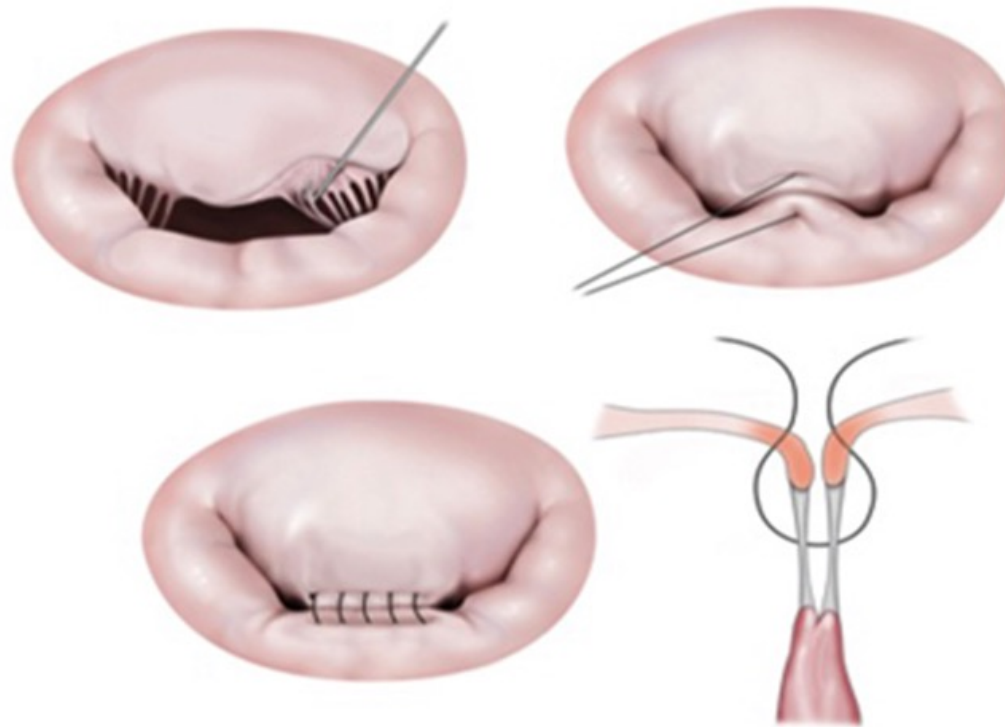


David TE: J Thorac Cardiovasc Surg 2020;160:385-94

von Oppell UO, Mohr FW. Ann Thorac Surg. 2000;70:2166-8.

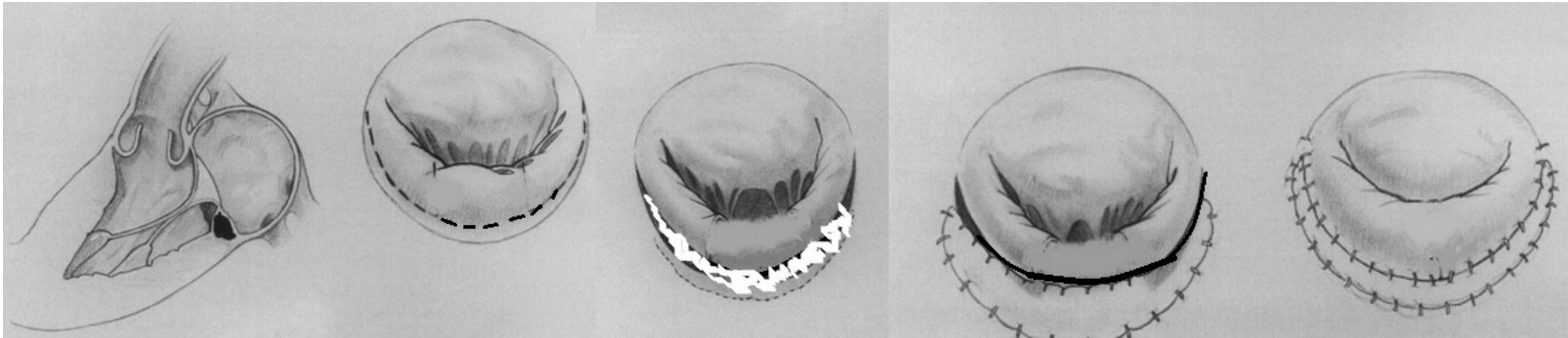


# Edge-to-edge Repair = Alfieri Stitch



Alfieri O, Maisano F. J Cardiac Surg.1999;14:468-70.

# Mitral Annulus Reconstruction for MAC or Abscess



David TE et al. Circulation. 1987; 76(III): III102-107.



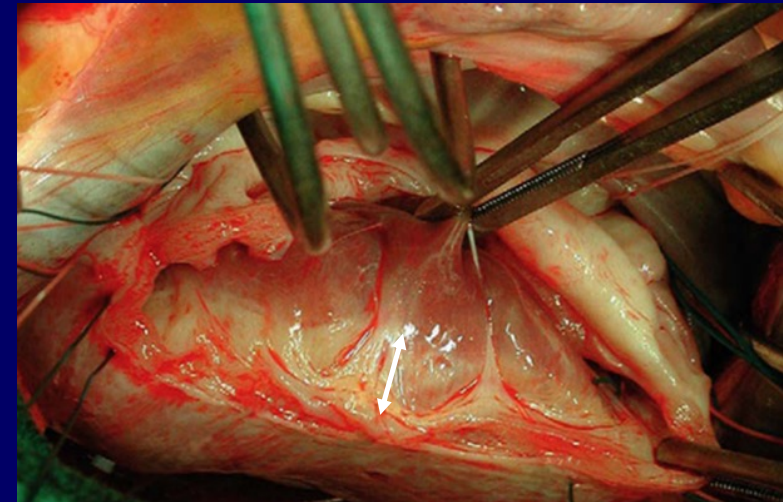
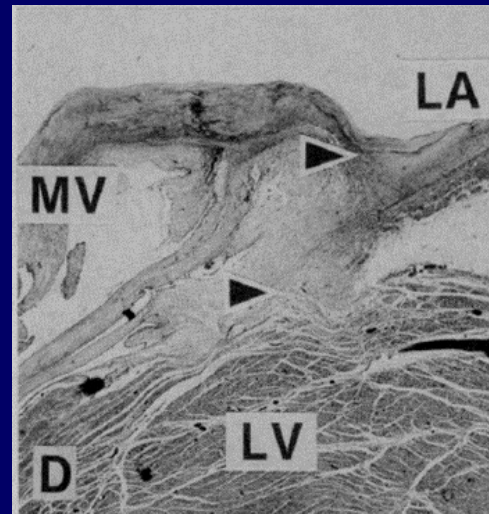
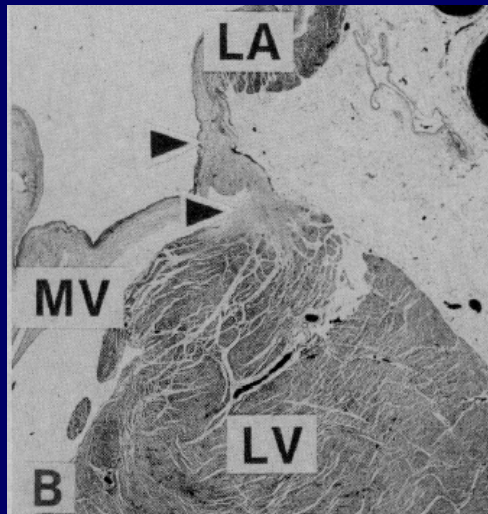
# Mitral Annulus Reconstruction





## The Association of Floppy Mitral Valve with Disjunction of the Mitral Annulus Fibrosus

Grover M. Hutchins, M.D., G. William Moore, M.D., Ph.D., and Dagna K. Skoog, M.D.



# MITRAL ANNULUS

Legends:

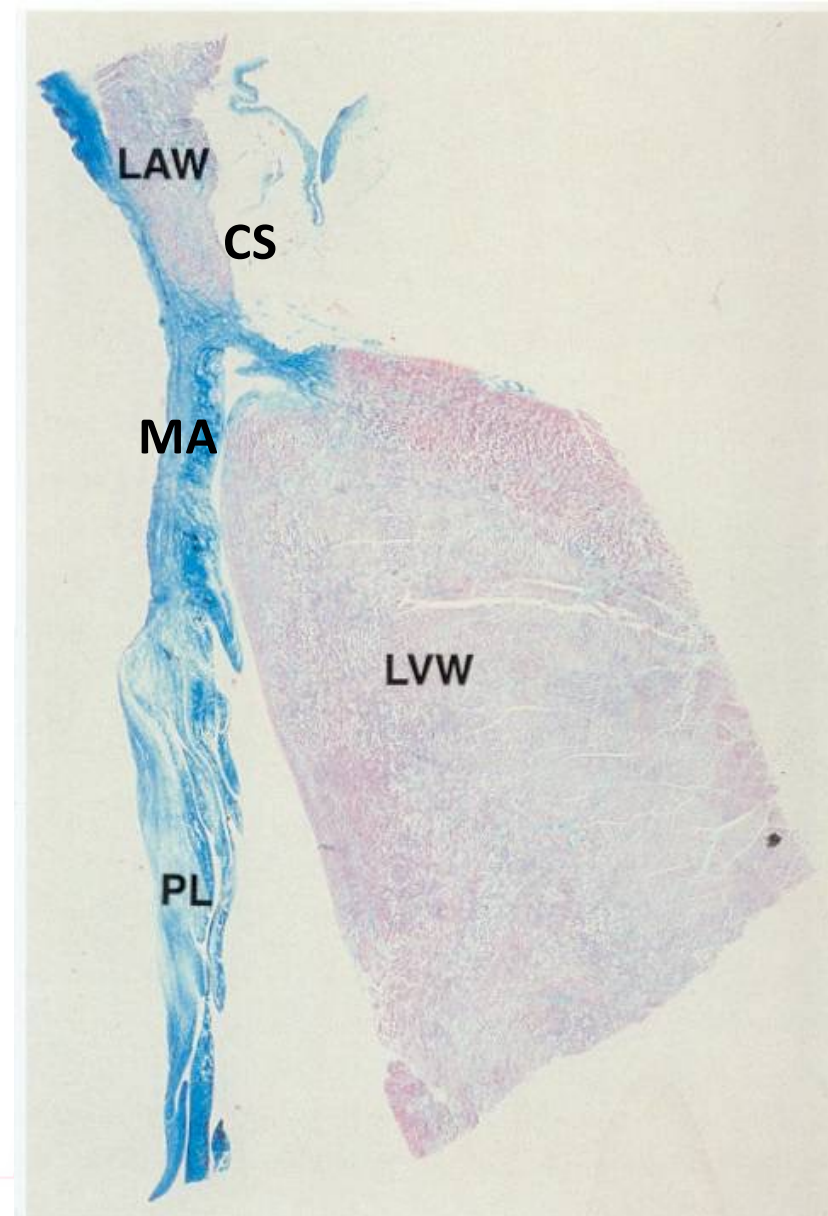
LAW = left atrial wall

CS = Coronary sinus

MA = Mitral annulus

LVW = left ventricular wall

PL = Posterior leaflet

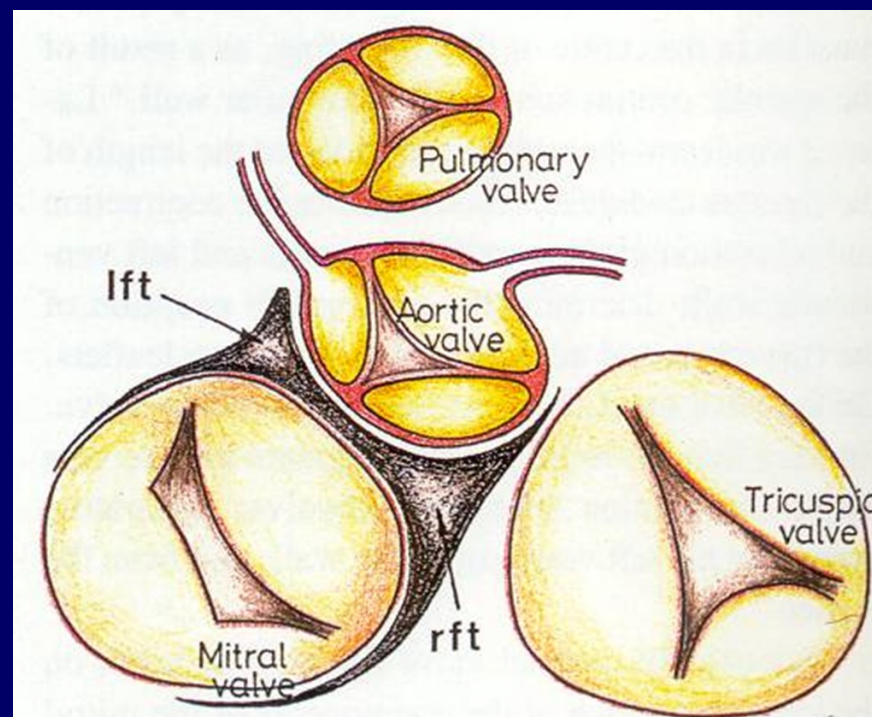


## The Association of Floppy Mitral Valve with Disjunction of the Mitral Annulus Fibrosus

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Letter to the Editor:

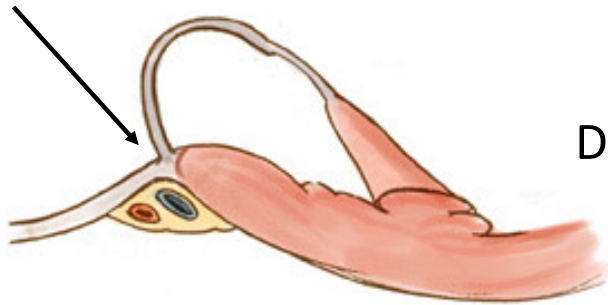
Angelini A, Ho SY, Anderson RH, Becker AE, Davies MJ.  
N Engl J Med. 1988;318:188-9



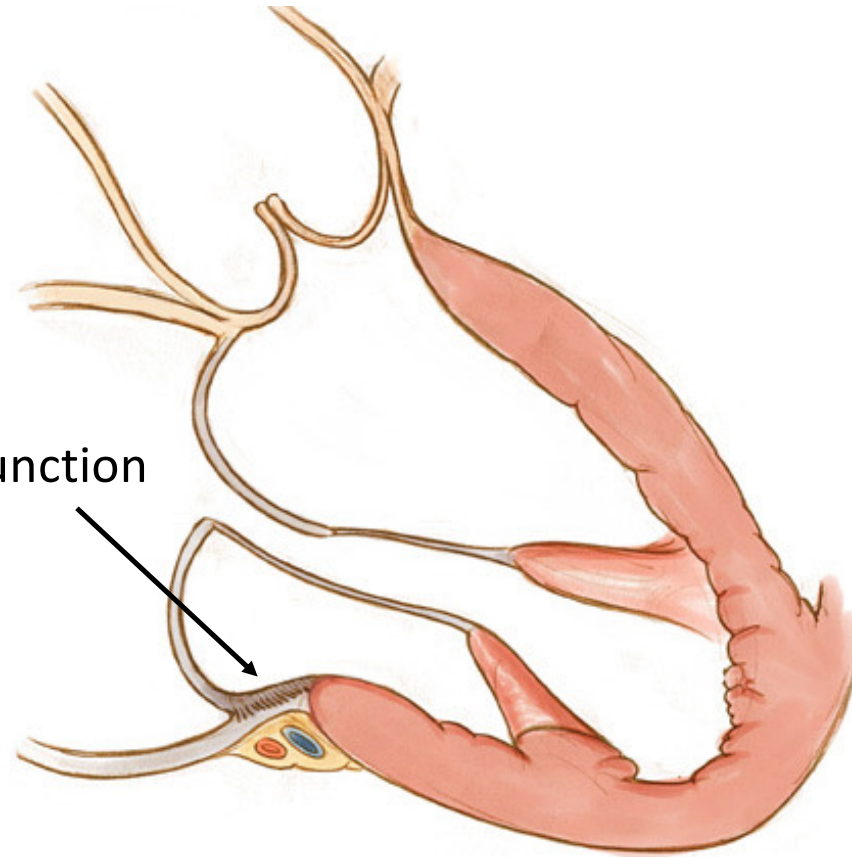


# Advanced Myxomatous Disease Mitral Annulus Disjunction

Normal



Disjunction



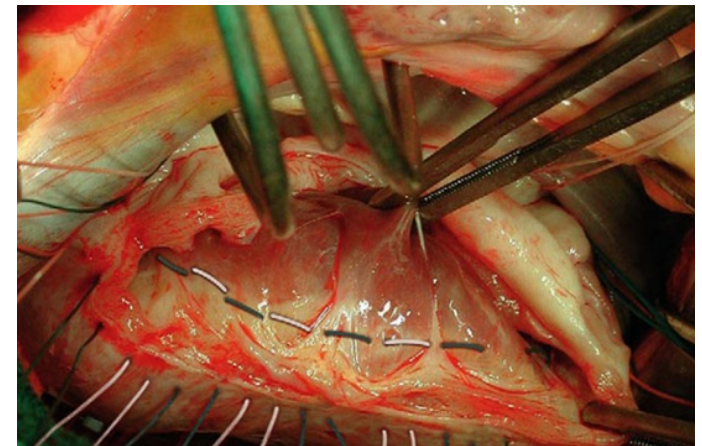
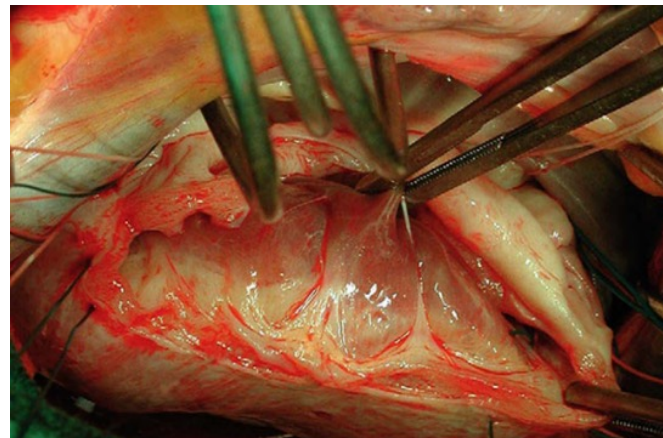
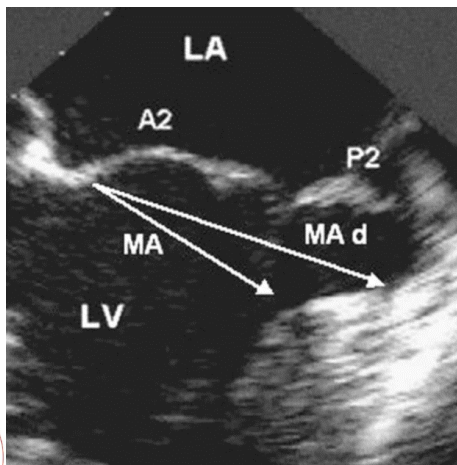
## ACQUIRED CARDIOVASCULAR DISEASE

### Mitral valve repair for advanced myxomatous degeneration with posterior displacement of the mitral annulus

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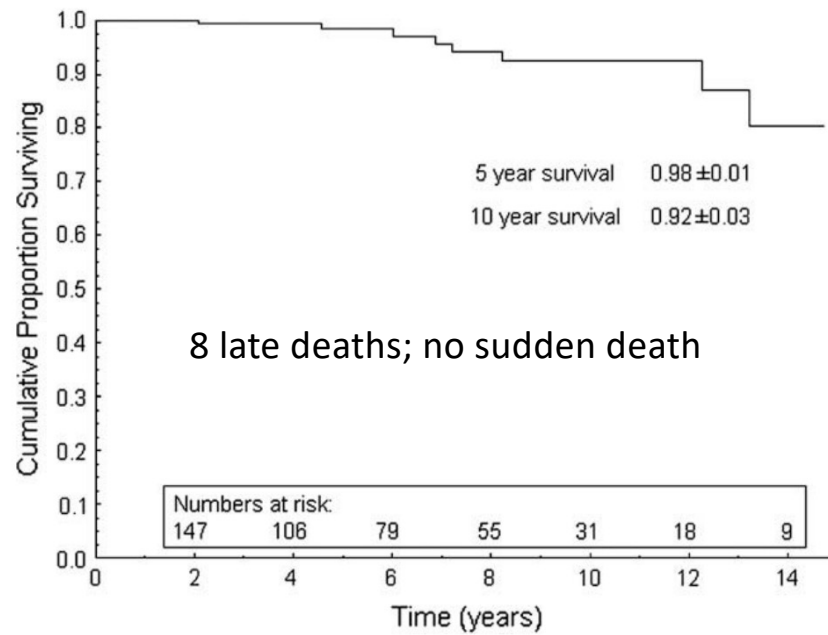
**J Thorac Cardiovasc Surg 2008;136:1503-9**

1990 – 2005 → 1032 patients with MV prolapse → 183 patients with MAD (mean age 52 years; 36% women)  
69% bileaflet prolapse. Median follow-up 5.9 years

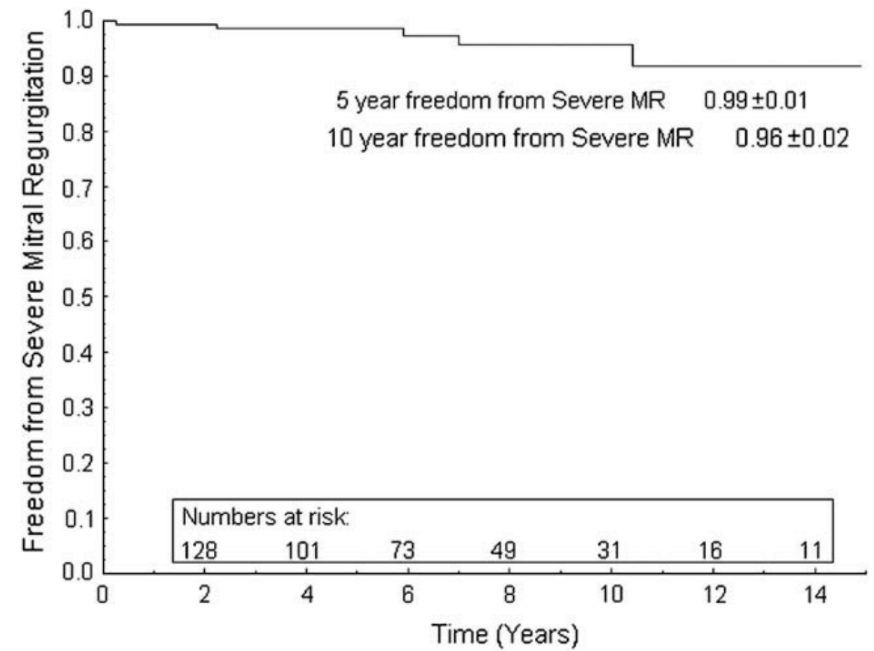


# MV Repair for Advanced Myxomatous Degeneration - MAD

## Patients' survival



## Freedom from severe MR





# MV Repair Beyond Carpentier's Techniques





## MV Repair Beyond Carpentier's Techniques

*MR due to leaflet prolapse is frequently associated with annular dilatation*

Annuloplasty is important for a durable repair

→ Is the type of ring or band important?



# Mitral Annuloplasty Rings & Bands



... and many others



# Mitral Annuloplasty: Rigid vs. Flexible

I use a 63 mm posterior flexible band for all cases of degenerative disease”

*Hartzell Schaff*

“I use a 50 mm long posterior band for all cases”

*Antonio Calafiori*

“It is not the ring... It is the ringer”

*Steven Bolling*

David TE et al - Ann Thorac Surg 2014;98:1551-6



# Mitral Annuloplasty for MR Due to Leaflet Prolapse

The type of annuloplasty device has no effect on the durability of MV repair

David TE et al. – Circulation 2013; 127:1485-92

Bacelli A. et al. Ann Thorac Surg. 2021; 112: 756-62

Del Forno B et al. – Ann Thorac Surg 2023; 115:421-7







# MV Repair for MR Due to Leaflet Prolapse



## DEGENATIVE MV DISEASES

- Fibroelastic deficiency
- Myxomatous degeneration
- Dystrophic calcification of the mitral annulus



# Myxomatous Degeneration of the MV

Mild



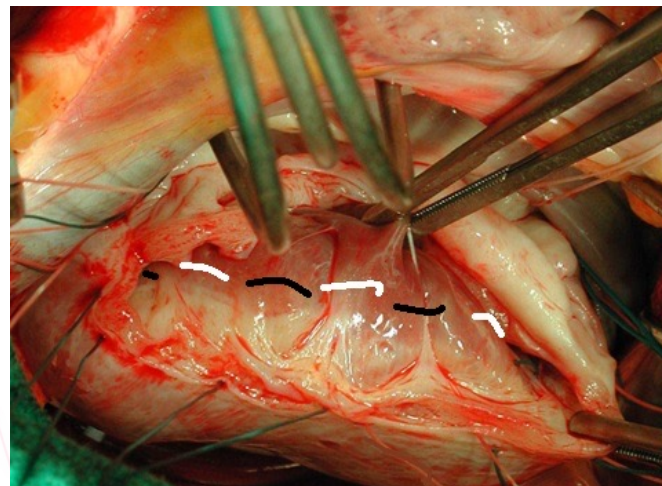
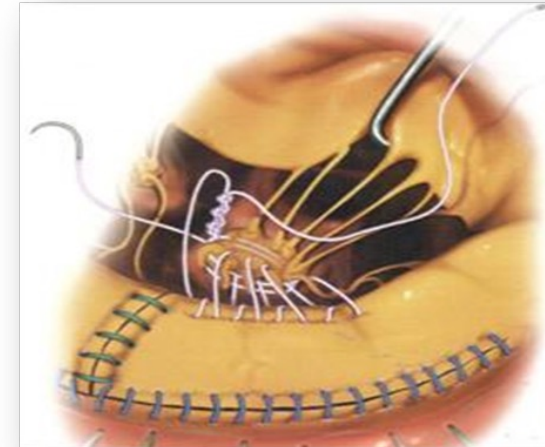
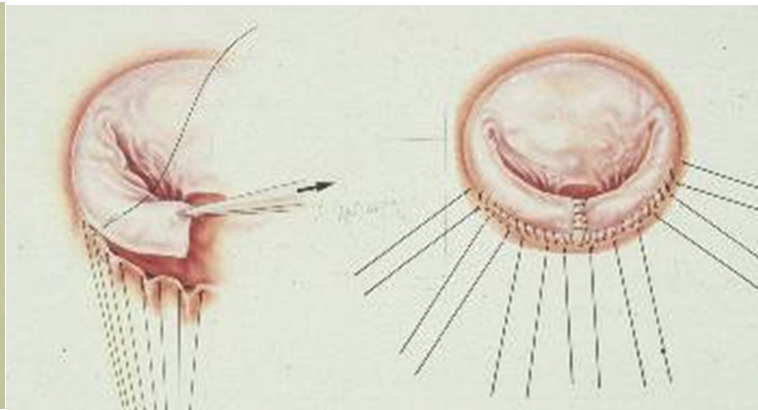
Moderate



Advanced



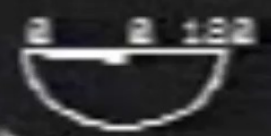
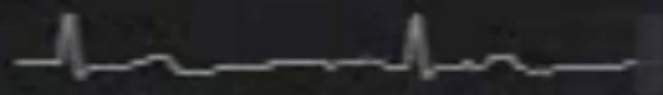
# Myxomatous Degeneration: Mild → Advanced (...MAD)



MI: 0.3  
T6210  
17 SEP 99  
09:37:22  
PROC R/O/D/F3  
THE TORONTO  
HOSPITAL

PAT T: 37.0C  
TEE T: <37.0C

1:15:17.28  
GAIN 33  
COMP 47  
55BPM  
6CM





# Intraoperative Complications of MV Repair



Persistent MR: Moderate → Back on the pump: re-repair  
Mild → Residual prolapse?  
Restricted leaflet?

Systolic anterior motion → MR?  
Gradient?

Wall motion abnormality → MV repair: circumflex  
TV repair: right coronary artery





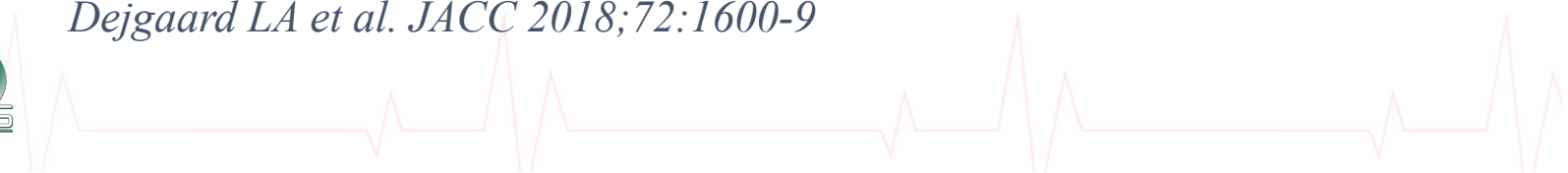
# Mitral Valve Prolapse and Sudden Cardiac Death

**Malignant MVP:** bileaflet prolapse → MAD  
female gender  
frequent complex PVCs

*Sriram CS et al. J Am Coll Cardiol 2013;62:222-30*

*Basso C et al. Circulation. 2015;132:556-66*

*Dejgaard LA et al. JACC 2018;72:1600-9*



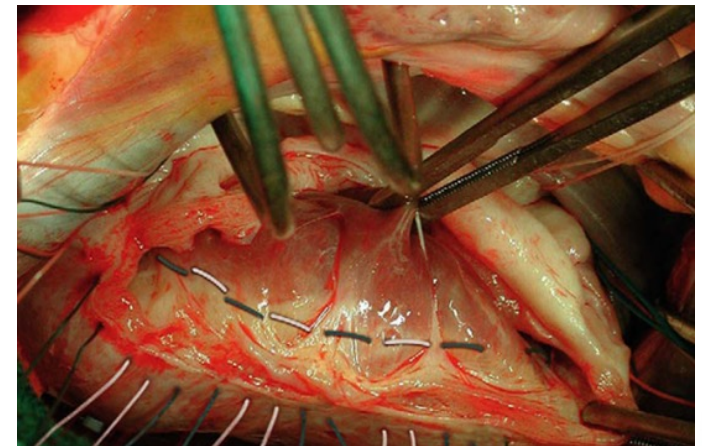
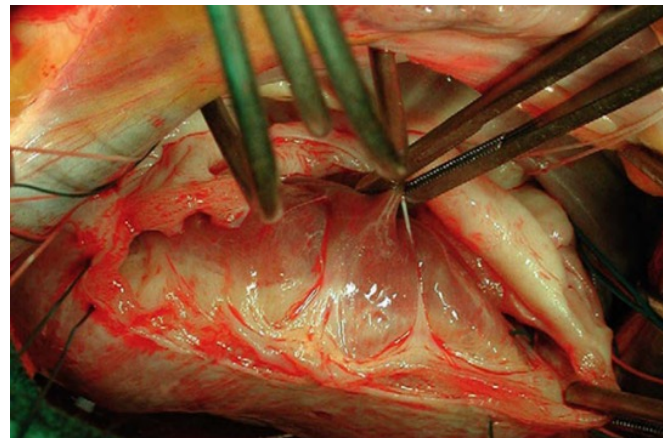
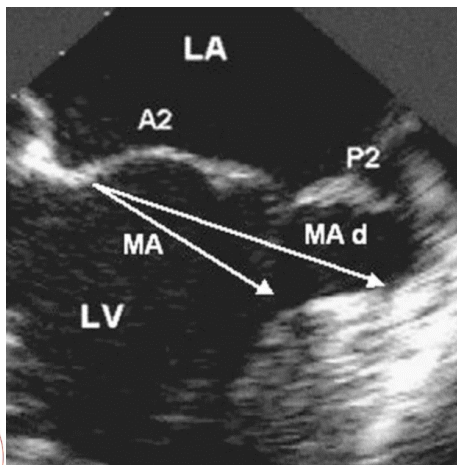
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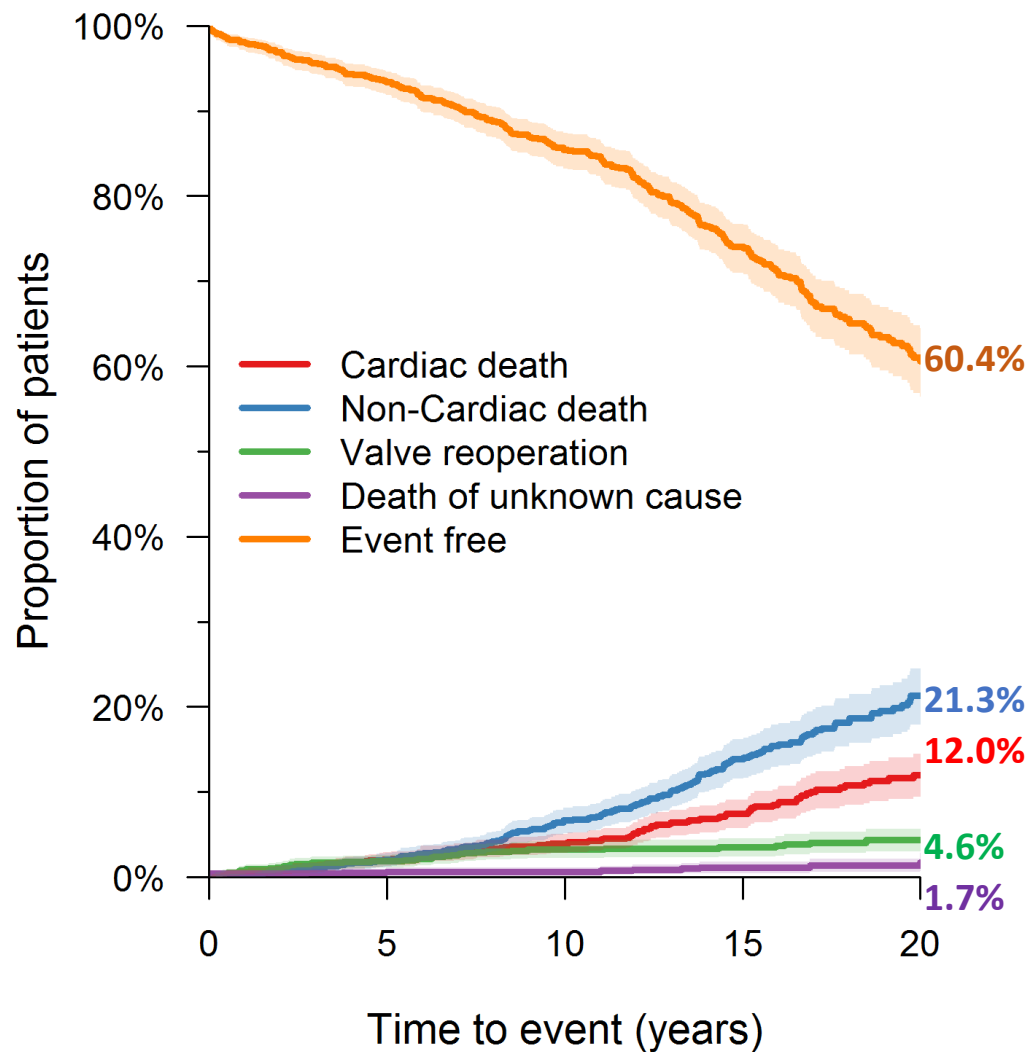
# Long-Term Results of Mitral Valve Repair for Regurgitation Due to Leaflet Prolapse



Tirone E. David, MD, Carolyn M. David, BA, Wendy Tsang, MD, Myriam Lafreniere-Roula, PhD, Cedric Manlhiot, PhD

1,234 patients; mean age 59 years; 70.4% men  
Median follow-up: 13 years (159 patients at risk at 20 years)  
Echocardiography median follow-up: 11 years; 96% complete





At-risk: 1,241      1,132      760      450      163

# MV Repair:

## Summary of outcomes

David TE et al. JACC 2019;74:1044–53

# MV Repair – Recurrent Moderate or Severe MR

## Results of Multivariable Analysis

	OR (95% CI)	p Value
Moderate or severe mitral regurgitation		
Time (1-yr increment)	1.087 (1.064-1.112)	<0.001
Age (5-yr increment)	1.210 (1.100-1.329)	<0.001
Pre-operative complete heart block	4.403 (1.852-10.471)	<0.001
Mitral annuloplasty ring (ref: posterior band)		
No ring	2.168 (1.225-3.836)	0.008
Carpentier	1.146 (0.631-2.080)	0.65
Duran	1.609 (0.959-2.699)	0.072
Degree of myxomatous degeneration (ref: mild)		
Moderate	1.258 (0.821-1.927)	0.292
Severe	2.885 (1.732-4.806)	<0.001

## MV Repair: Sudden Death - Multivariable Analysis

Sudden cardiac death	OR (95% CI)	
Left ventricular ejection fraction (ref: >60%)		
40%-59%	4.015 (1.705-9.454)	0.002
<40%*	—	—
Leaflet prolapse (ref: posterior leaflet only)		
Anterior leaflet only	0.737 (0.219-2.478)	0.62
Both leaflets	0.188 (0.056-0.635)	0.007

# Patients with MR Due to Leaflet Prolapse

Preoperative assessment:

Palpitations → Holter monitor

VT → CMR with gadolinium enhancement

ECG → Inverted T wave inferior wall → CMR?

MAD → Holter → CMR

Surgery: MV repair + correction of MAD

Ablation of base of arrhythmogenic area? AICD?



# Thank you

