Valve Repair/Replacement

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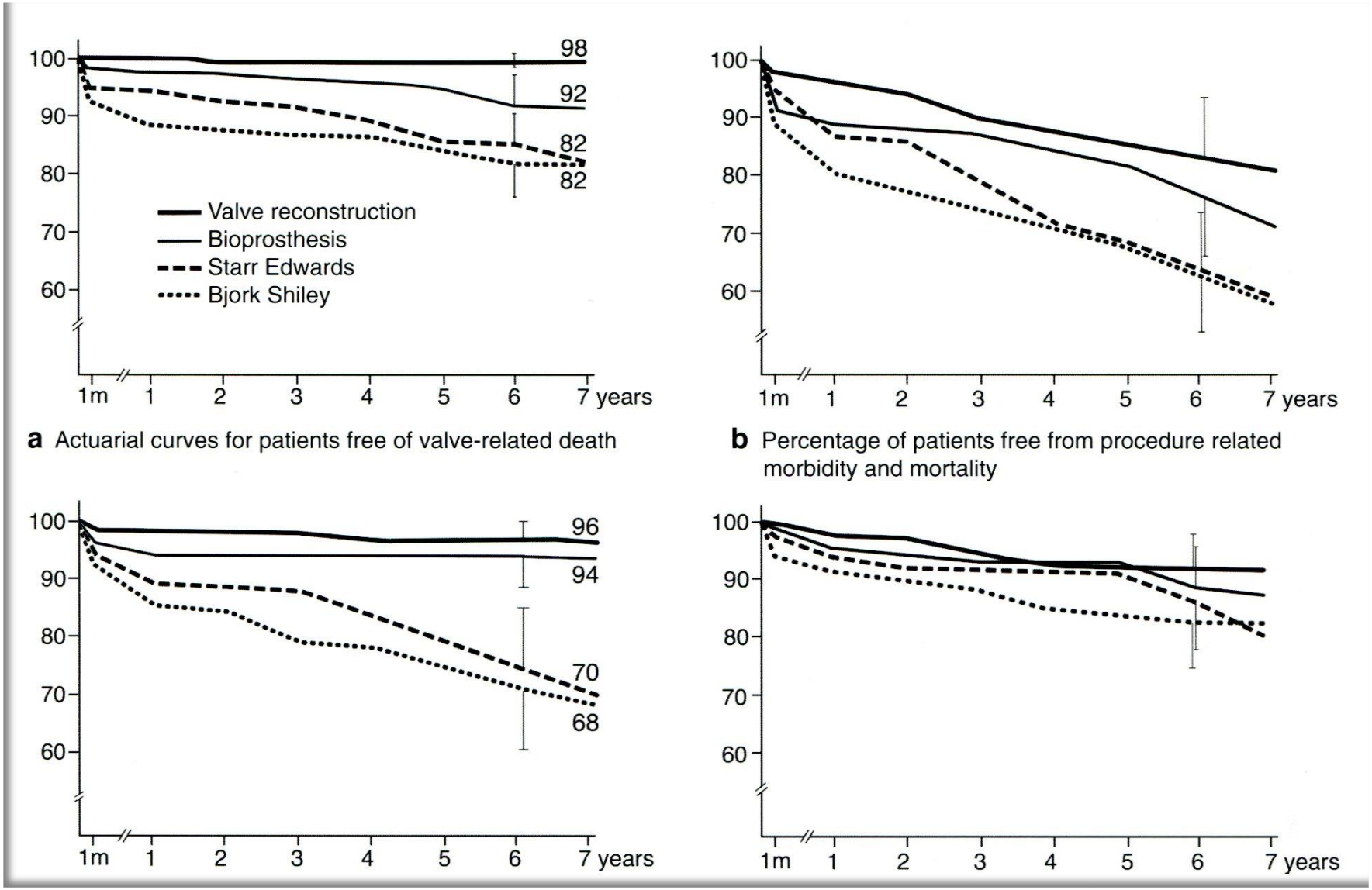
Introduction

- 1960s **Congenital malformation**
  Rheumatic valvular disease
  → Palliative valve repair/valve replacement

- 1970s **Rheumatic valvular disease**
  → Valve replacement(Mechanical, Tissue) / Repair

- 1980s **Degenerative valvular disease**(Echocardiography)
  → Functional valve analysis
  Reconstructive valve surgery

- 1990s **Ischemic/cardiomyopathy**
  (Atrial fibrillation : Maze operation)
  → Nonthrombogenic valve surgery

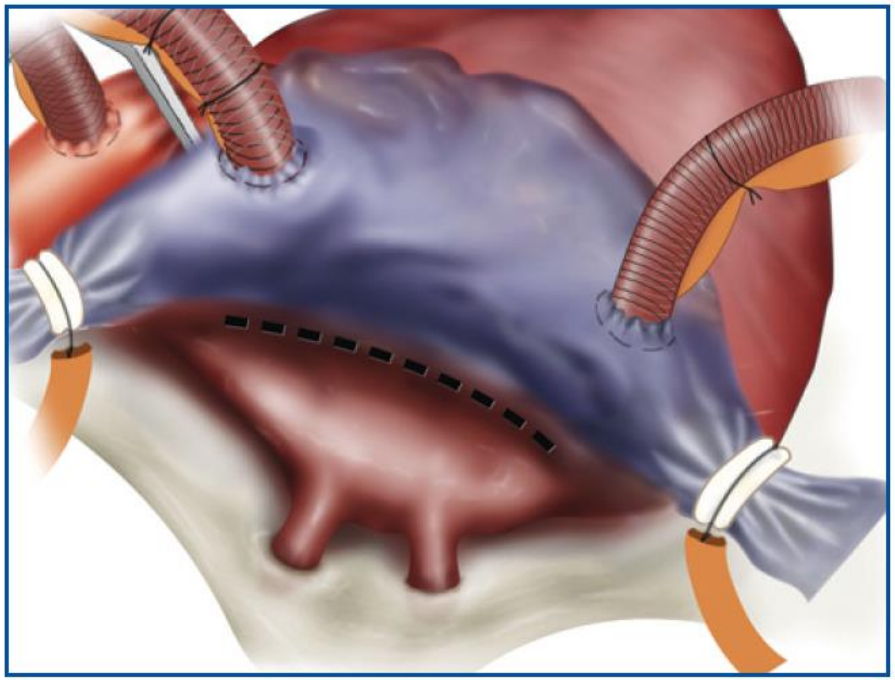


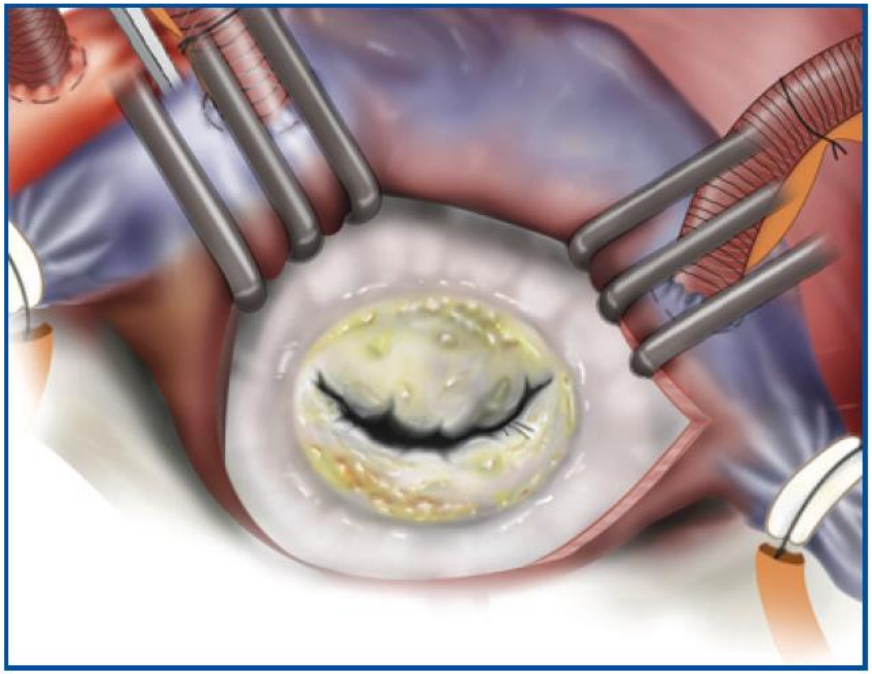
Perier P, et al ***Comparative evaluation of aortic valve replacement with Starr, Björk, and porcine valve prostheses*** Circulation Sep;72(3 Pt 2):II140-5.

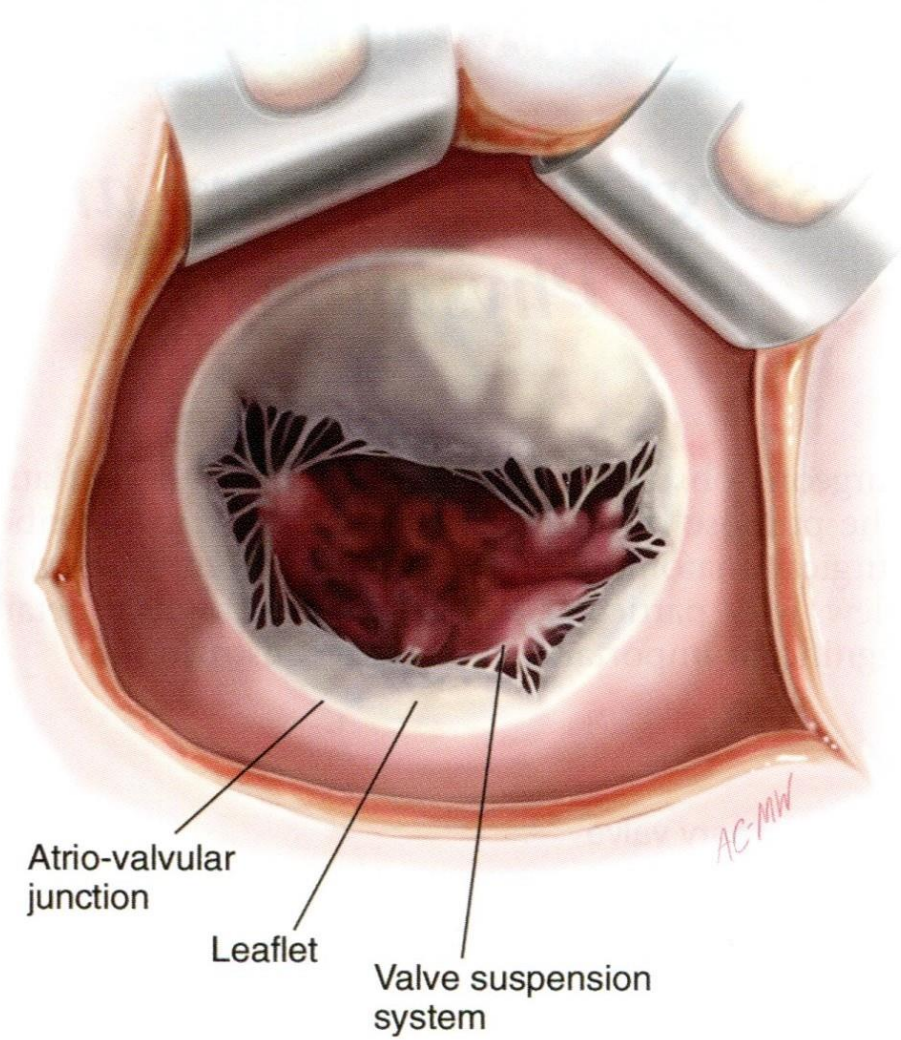
1985

Mitral valve replacement

Mitral valve exposure !!!!!!

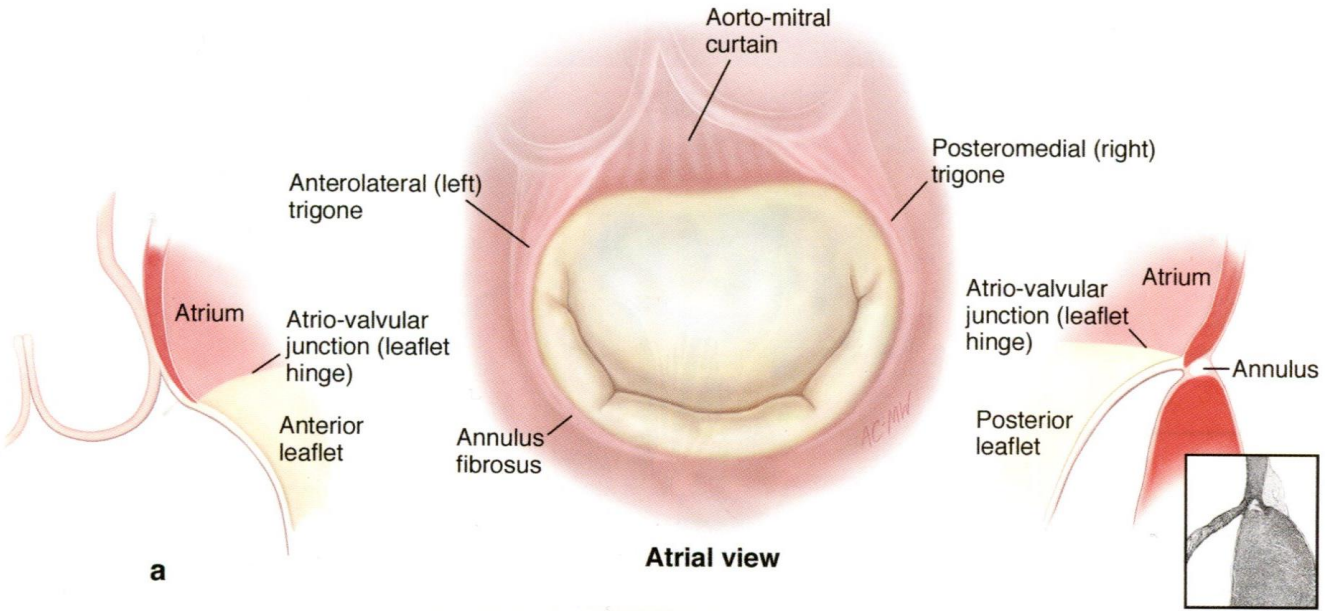


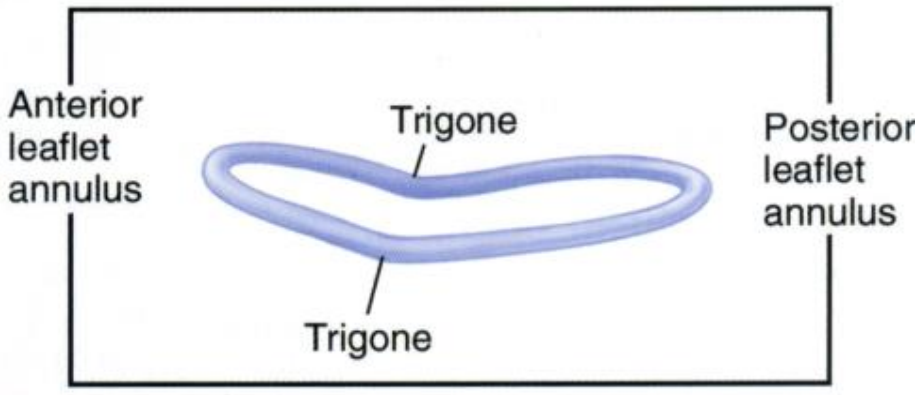


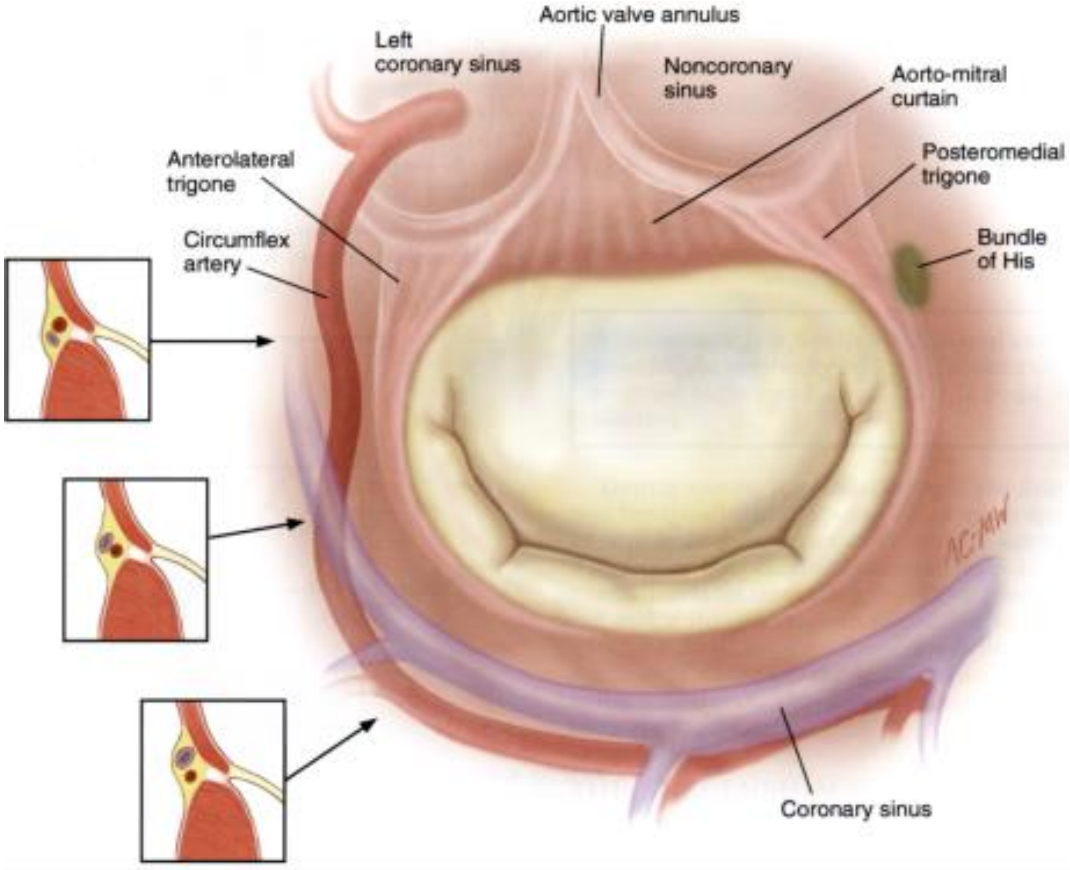


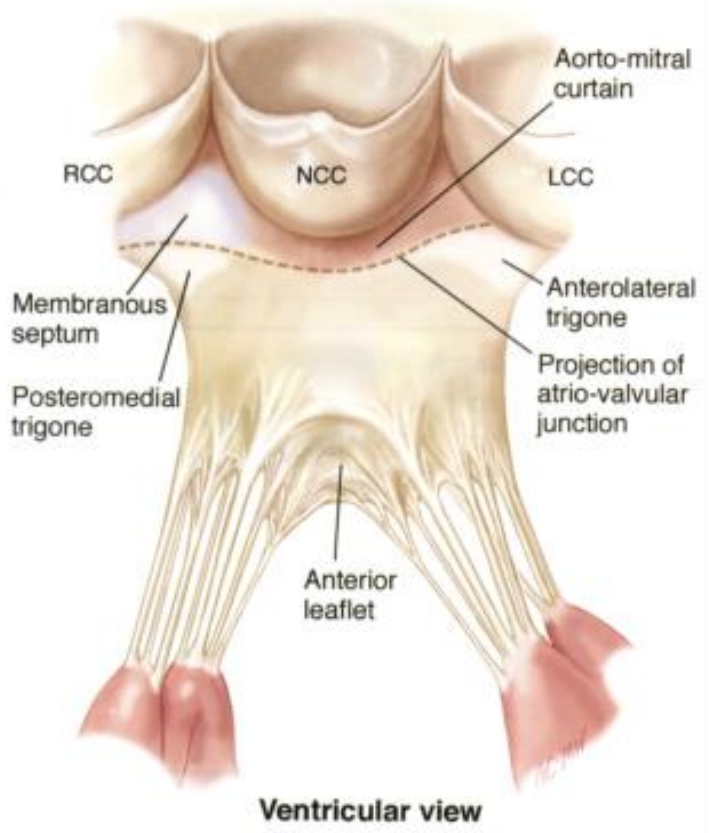
- **Atrio-valvular junction**
- **Leaflet**
- **Suspension system**
  - Chordae
  - Papillary muscle

Annulus


Aorto-mitral curtain
Anterolateral (left) trigone
Posteromedial (right) trigone
Atrium
Atrio-valvular junction (leaflet hinge)
Anterior leaflet
Annulus fibrosus
Atrial view
a
Atrio-valvular junction (leaflet hinge)
Atrium
Annulus
Posterior leaflet


Anterior leaflet annulus
Trigone
Posterior leaflet annulus
Trigone

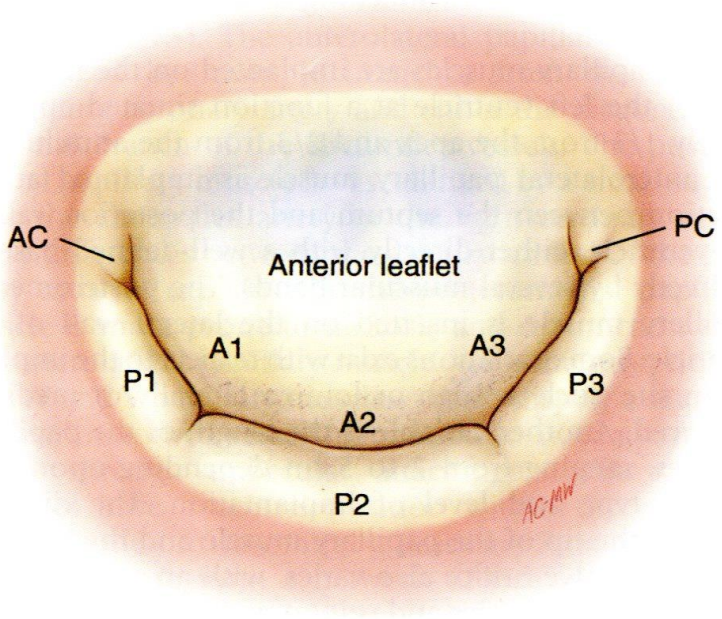

Aortic valve annulus
Left coronary sinus
Noncoronary sinus
Aorto-mitral curtain
Posteromedial trigone
Anterolateral trigone
Circumflex artery
Bundle of His
Coronary sinus


Aorto-mitral curtain
RCC
NCC
LCC
Membranous septum
Anterolateral trigone
Projection of atrio-valvular junction
Posteromedial trigone
Anterior leaflet
Ventricular view

Leaflet

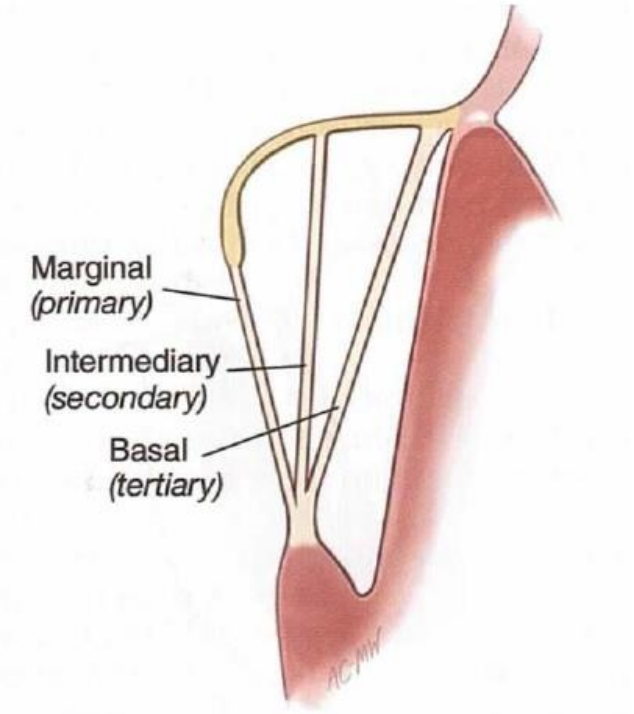
- **Anterior leaflet** : triangular – A1, A2, A3
- **Posterior leaflet**(indentation)
  – P1, P2, P3

- AL commissure
- PM commissure



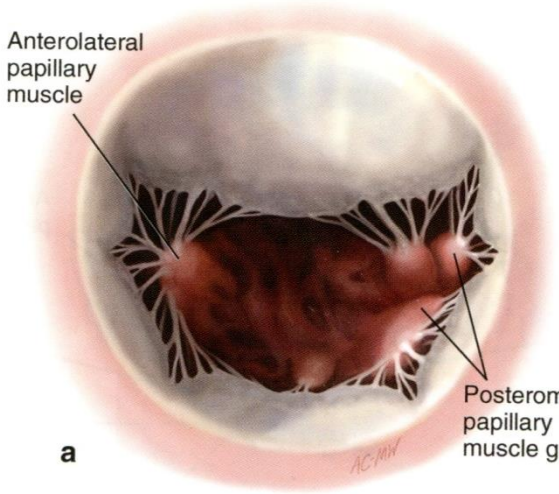
Chordae

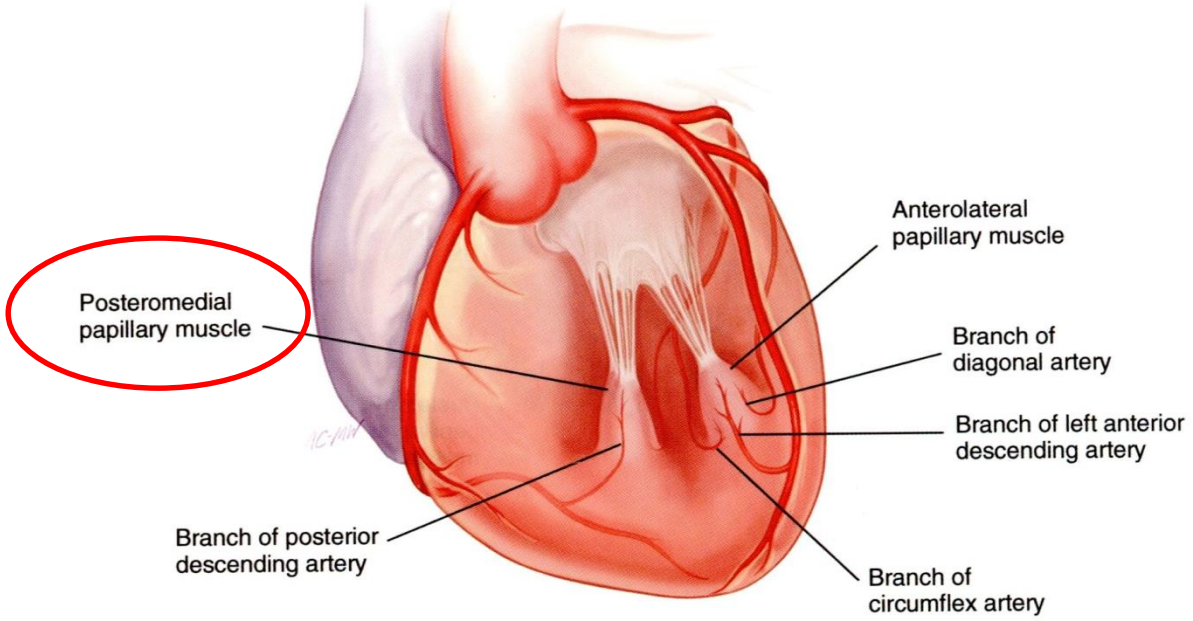
- **Marginal(primary)**
  : prevent eversion
- **Intermediary(secondary)**
  : prevent doming
- **Basal(tertiary)**
  : maintain geometery



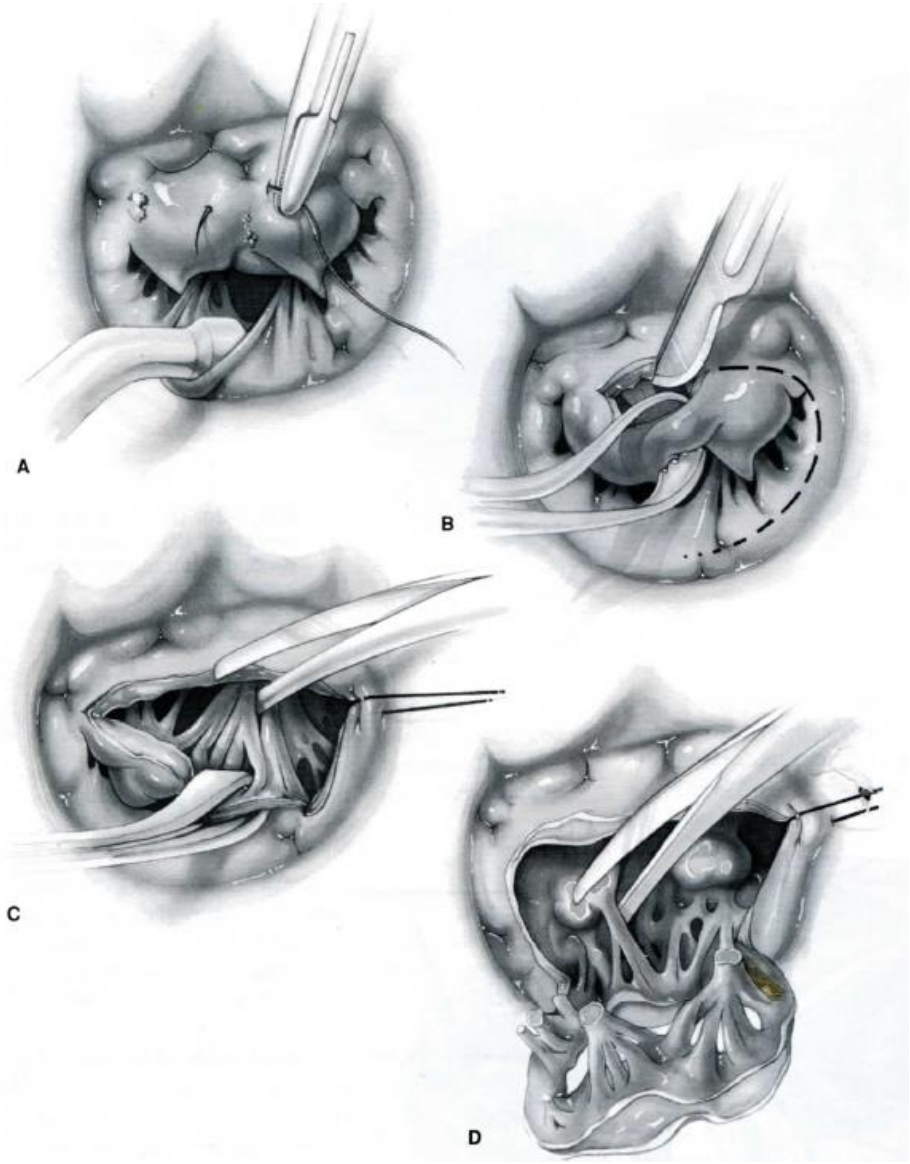
Papillary muscle

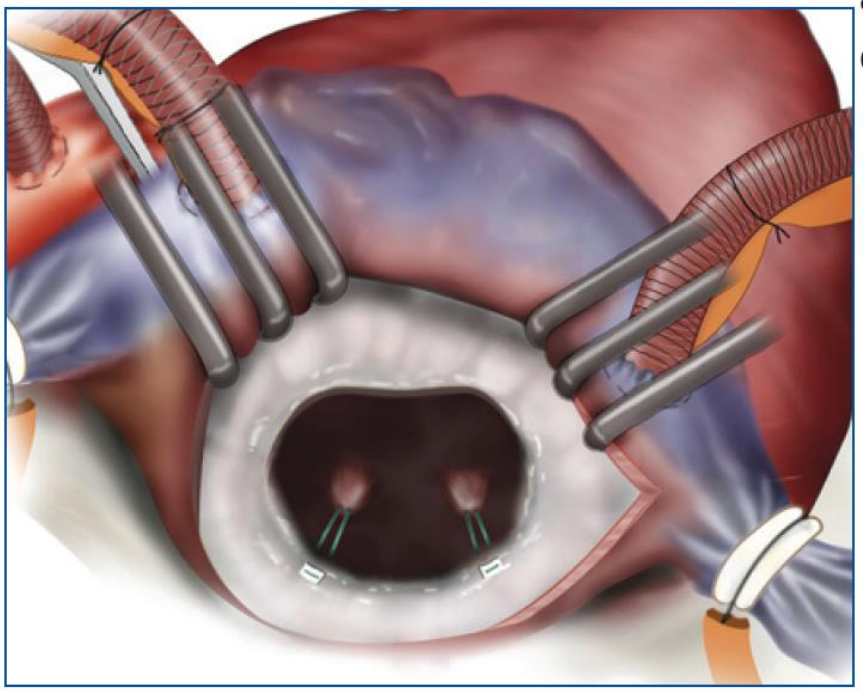
- Anterolateral PM
- Posteromedial PM



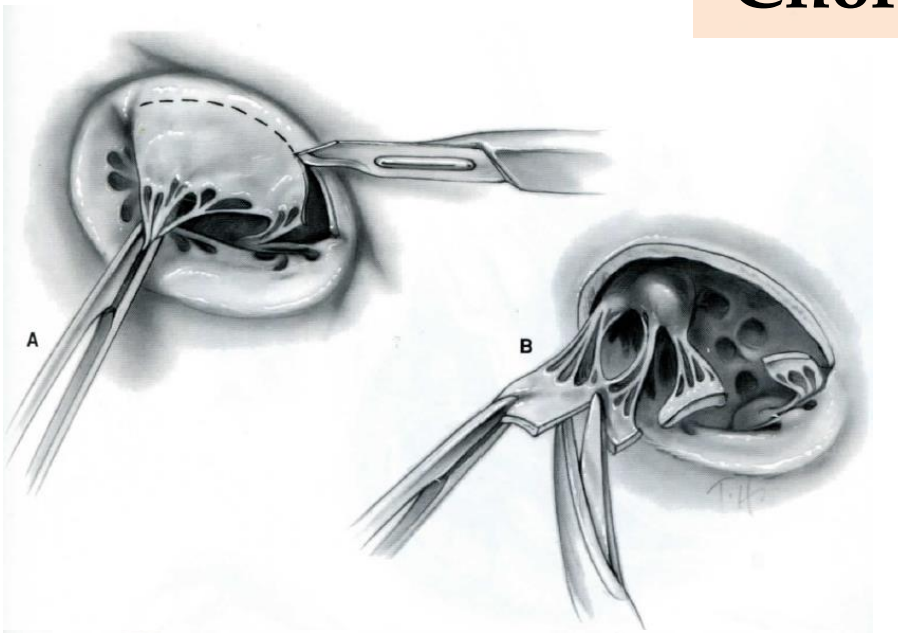


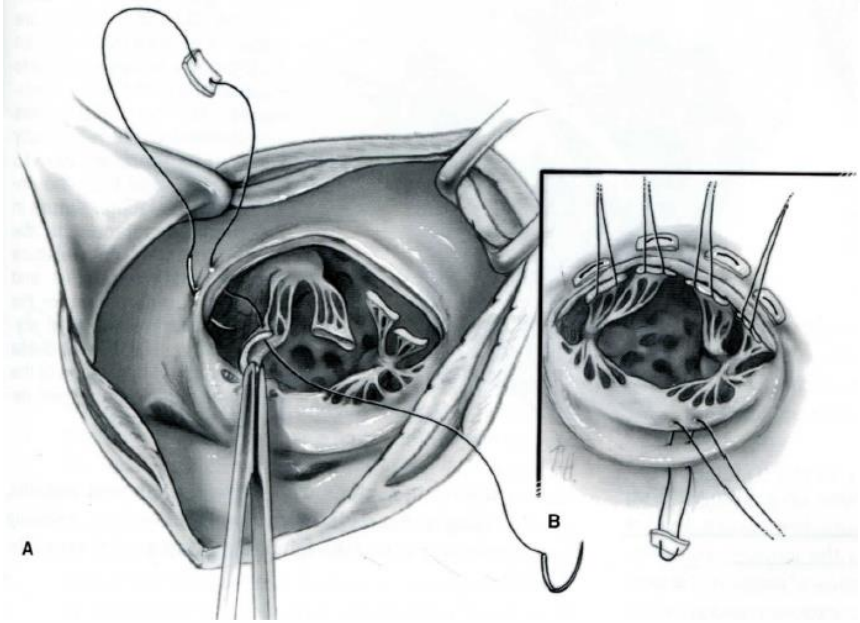
Mitral valve excision

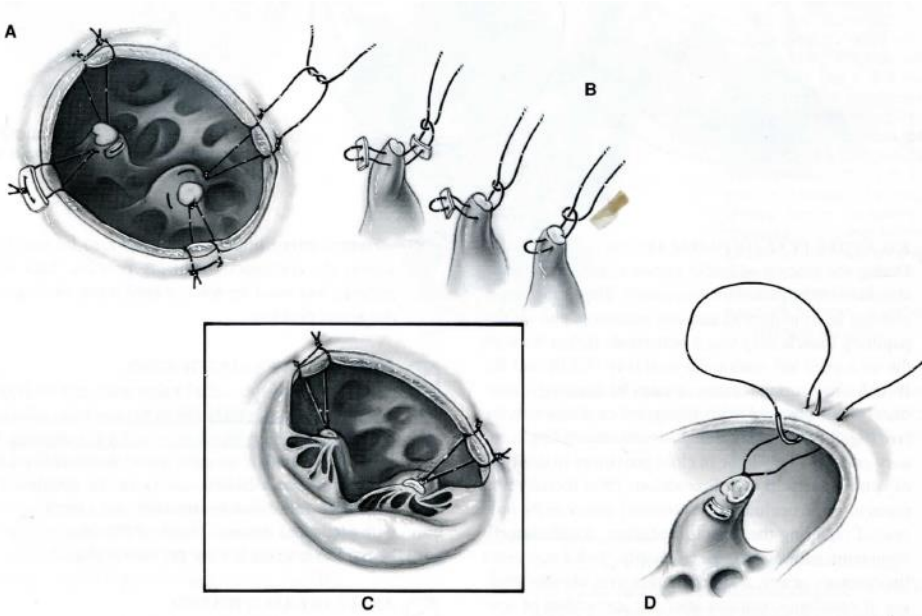




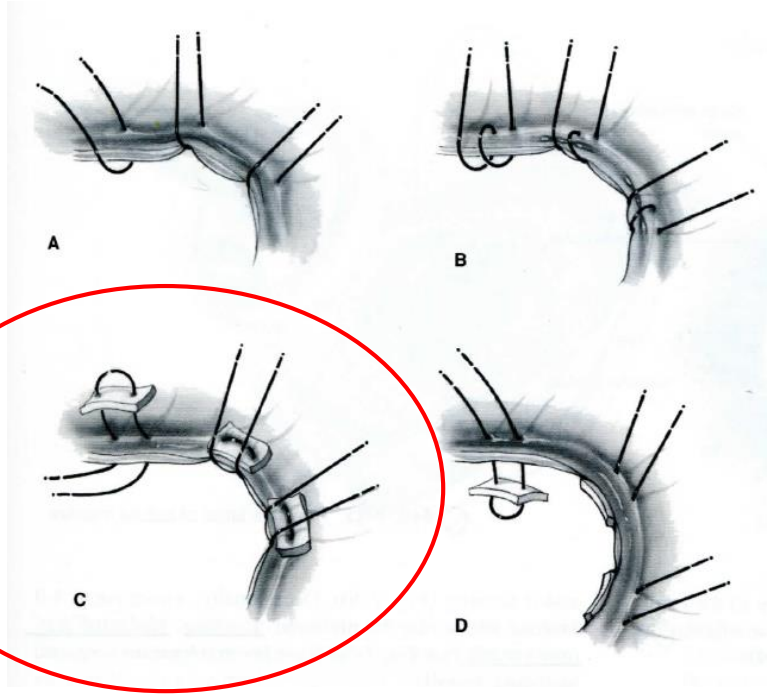
Chordal preservation







Valve suture insertion



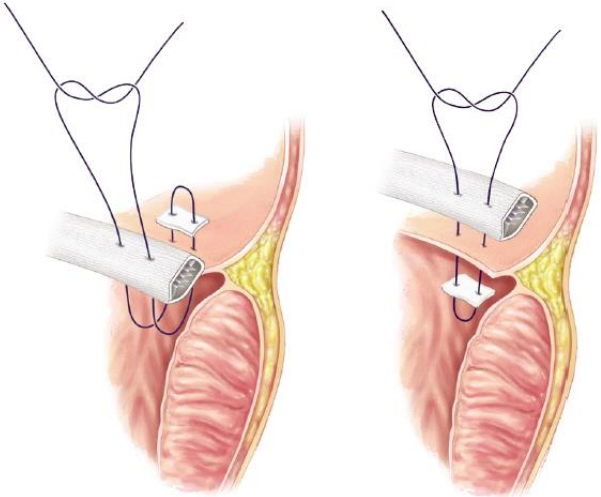
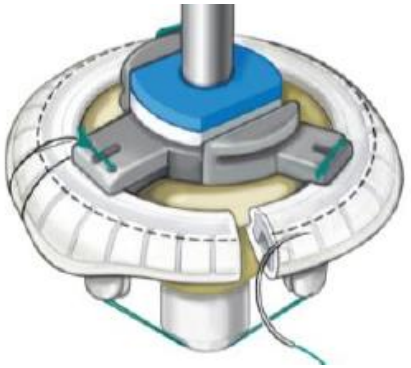
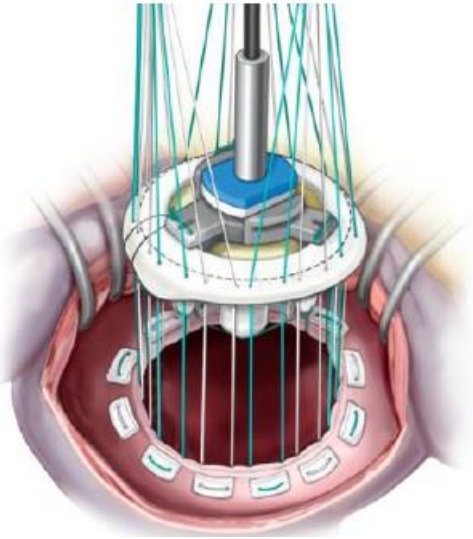
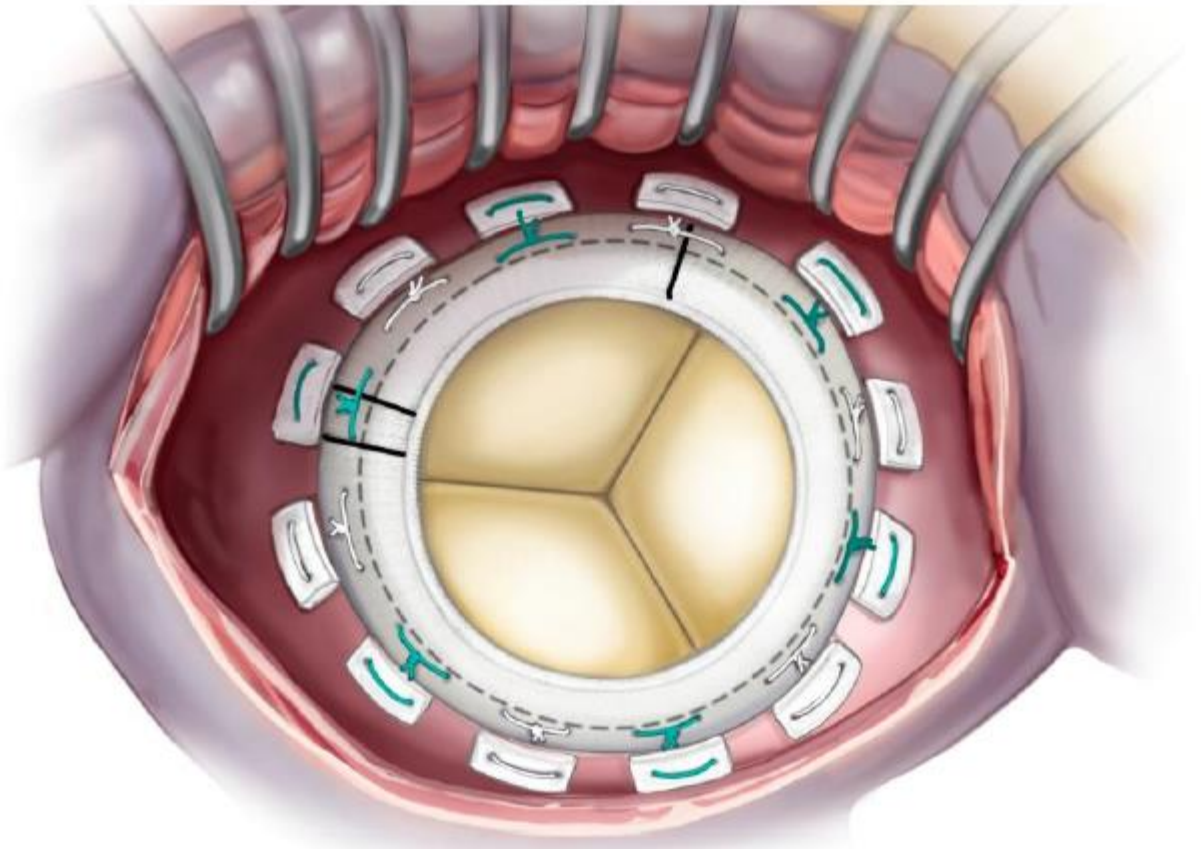


Figure 9

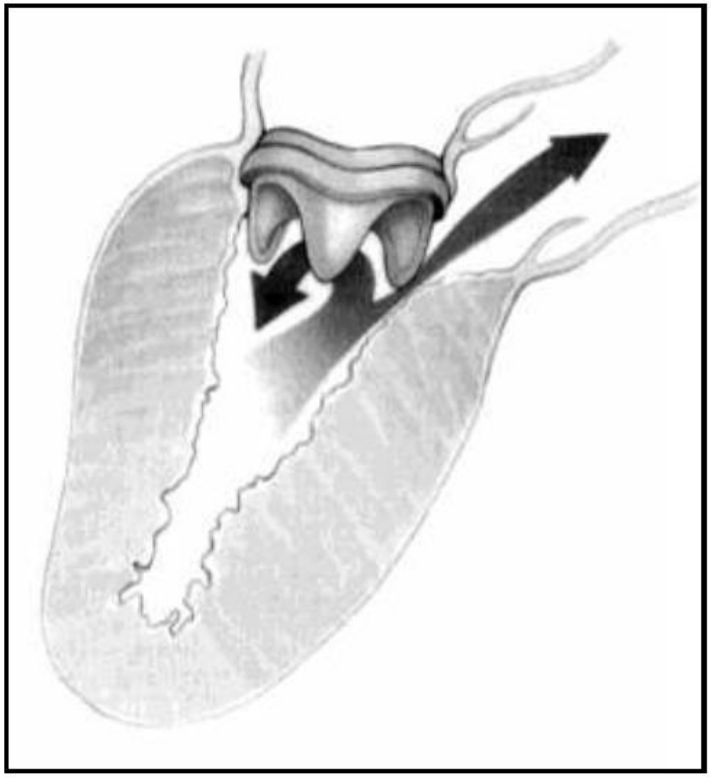


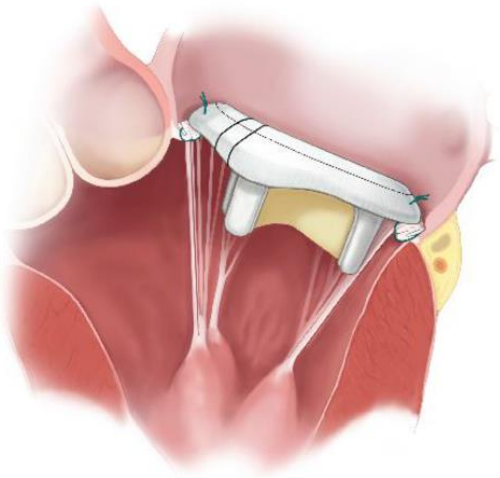


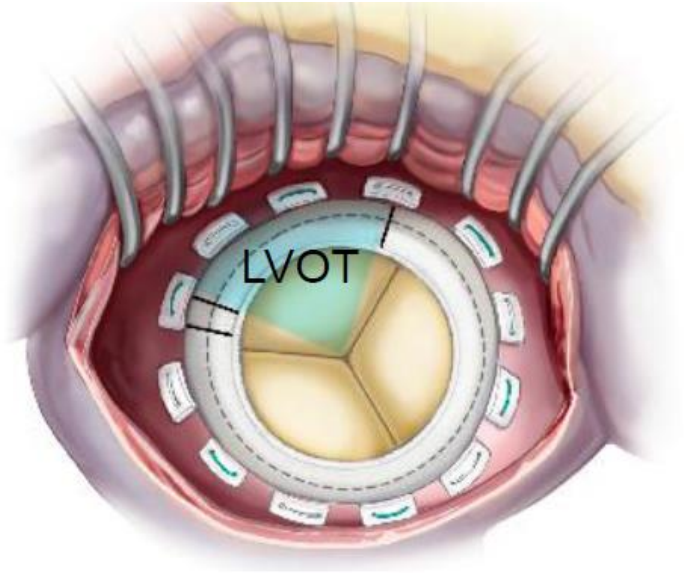
완성!!!!!



LVOT obstruction



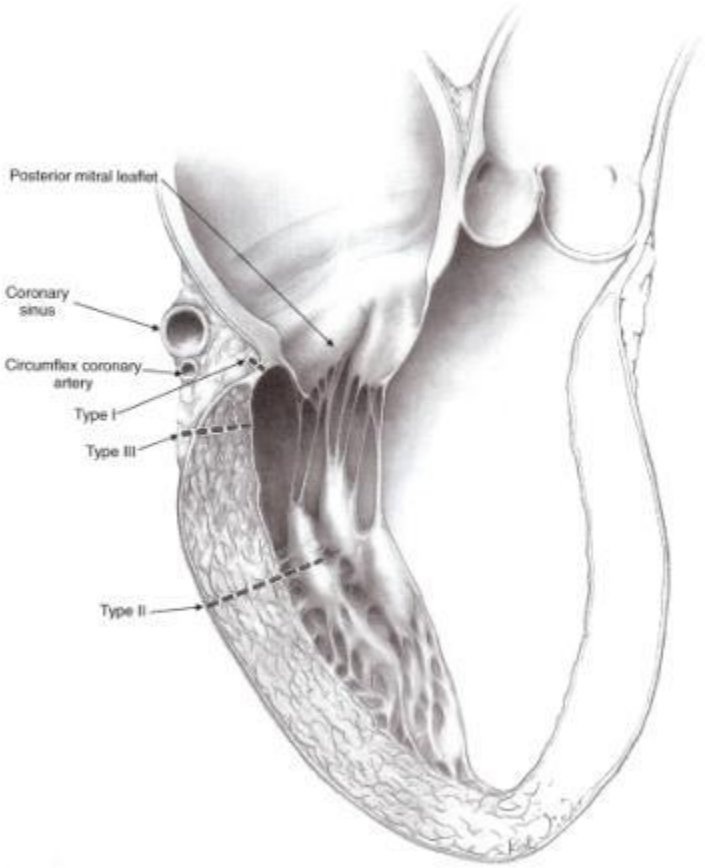




Left Ventricular Rupture

- Why?
  - High profile tissue valve
  - Lesser subvalvular apparatus
  - Injury during operation

➢ Should maintain annulopapillary continuity

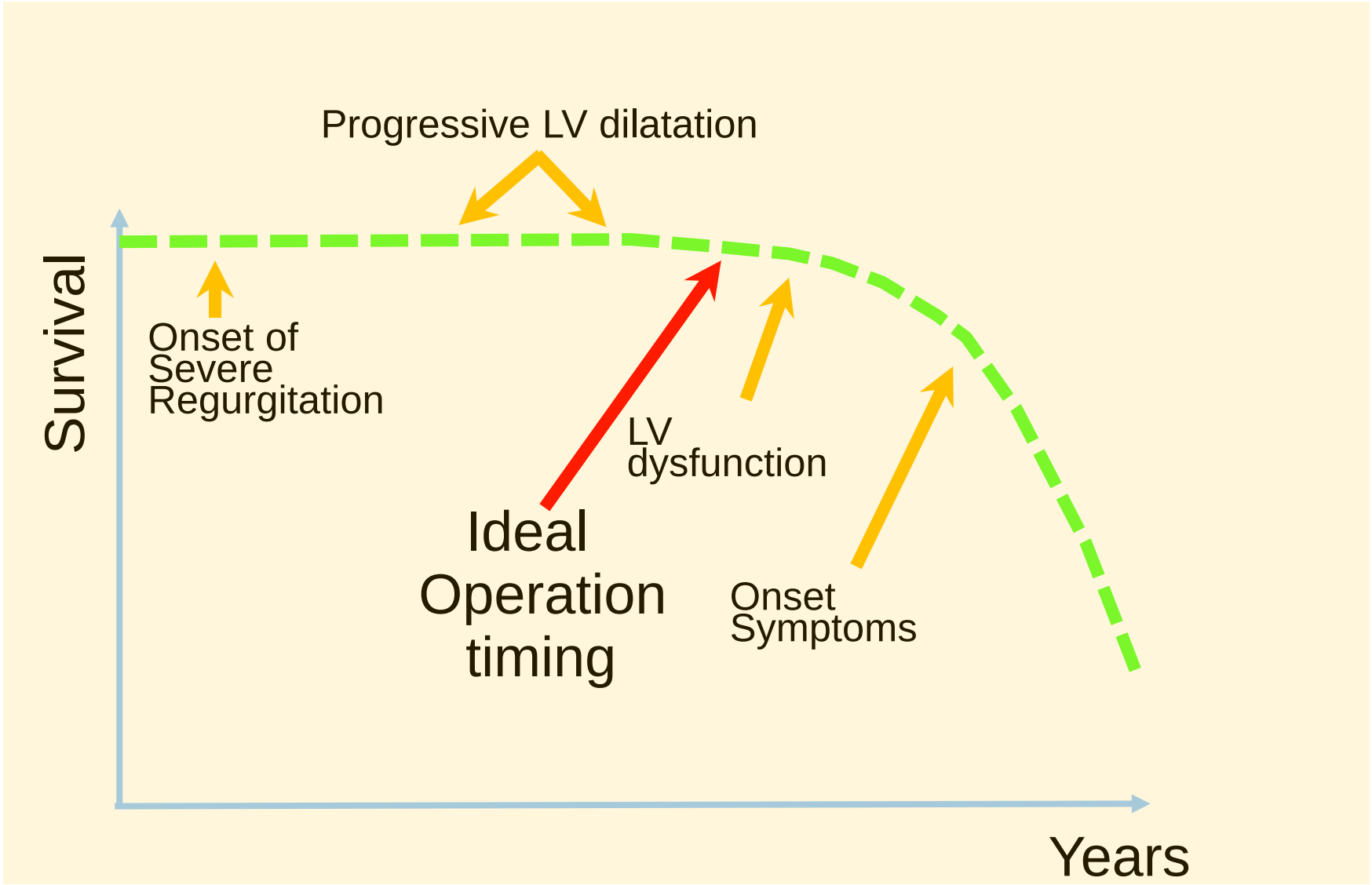


Mitral valve repair

Natural course of Mitral Regurgitation

- Annual mortality of asymptomatic MR
  - 6.3%/yr
  - After 10yr : 90% died
- Occult LV dysfunction
  : frequently predates symptoms in severe MR
- Medical Tx can produce
  - Congestive heart failure
  - Atrial fibrillation

Natural History



Benefits of MV repair

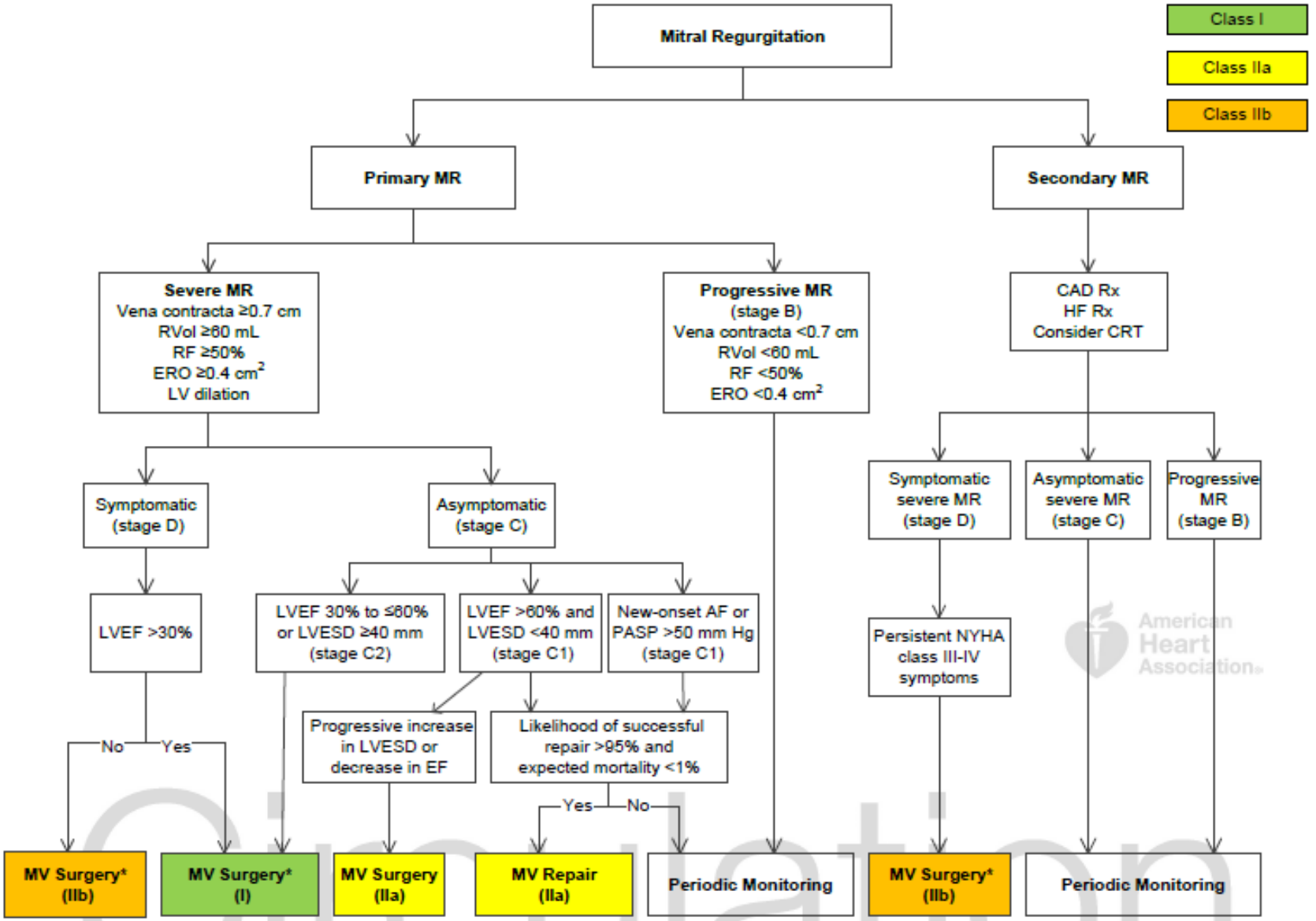
- Preservation of own valve within heart
- No need of anticoagulation
- Lower risk of prosthetic infection
- Lower risk of LV rupture

  : fatal complication of MV replacement

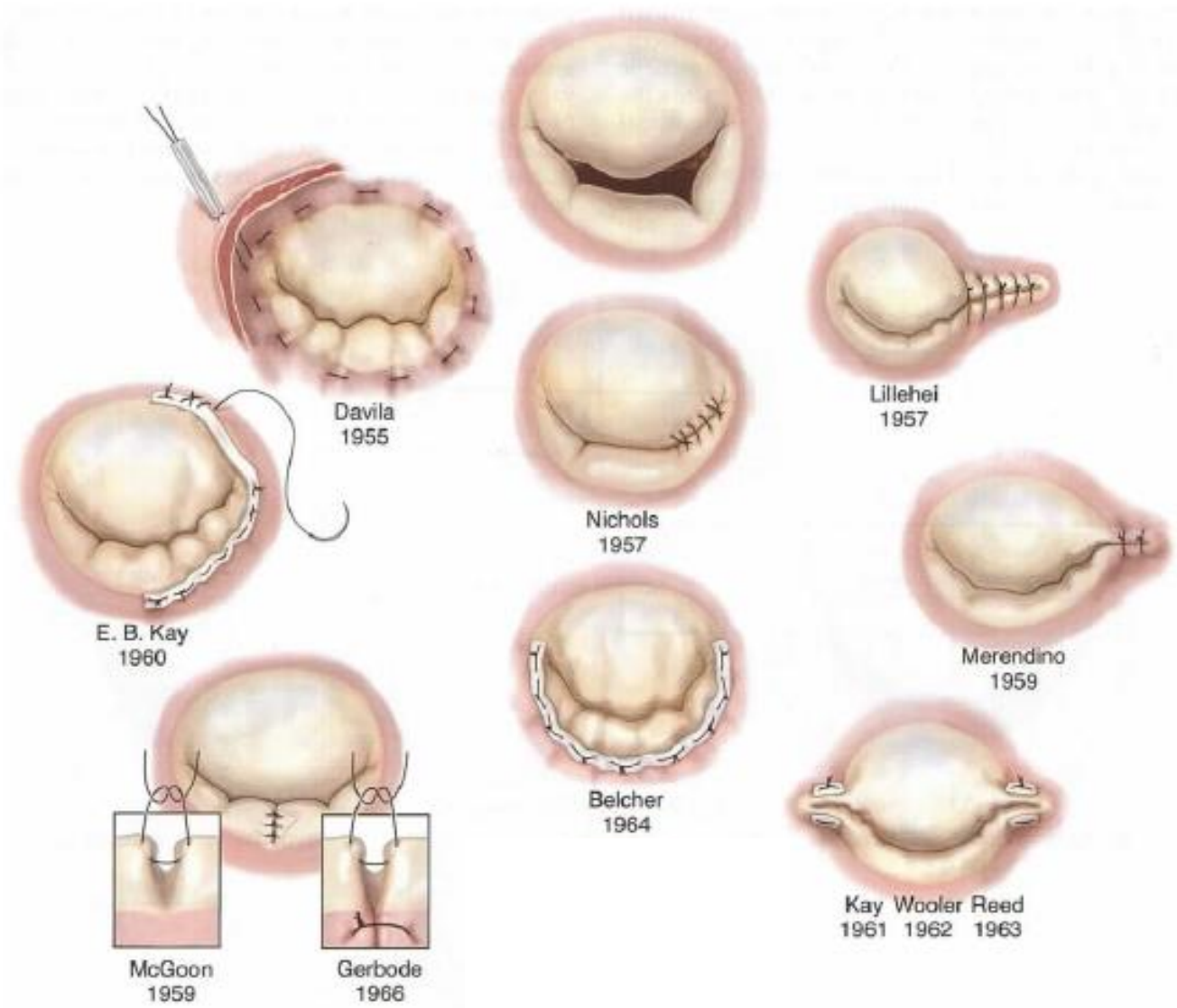
  – Resection of subvalvular structure during MVR

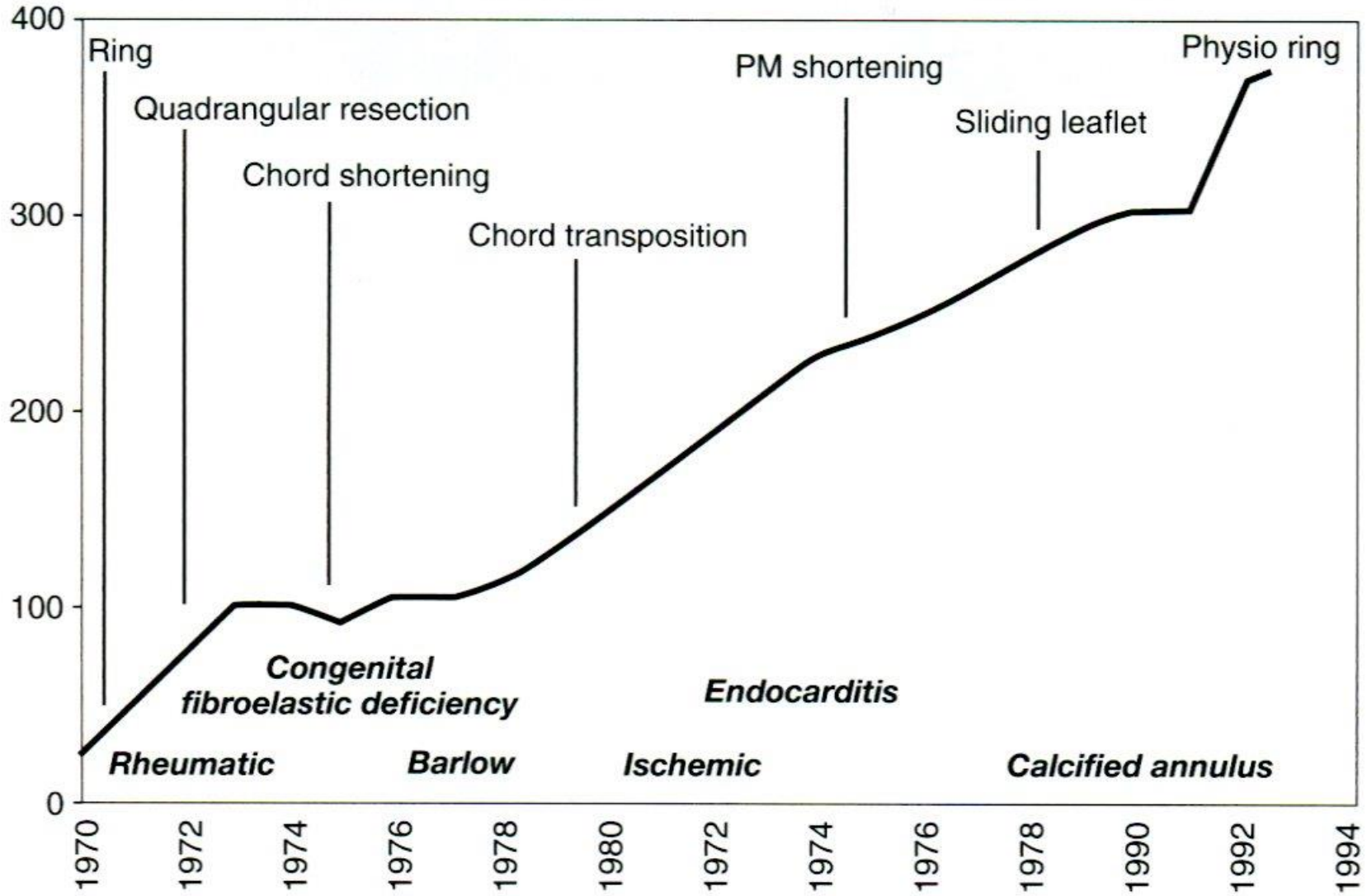
J Heart Valve Dis 2008;17:42-47

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease



1957-1968 Palliative Techniques



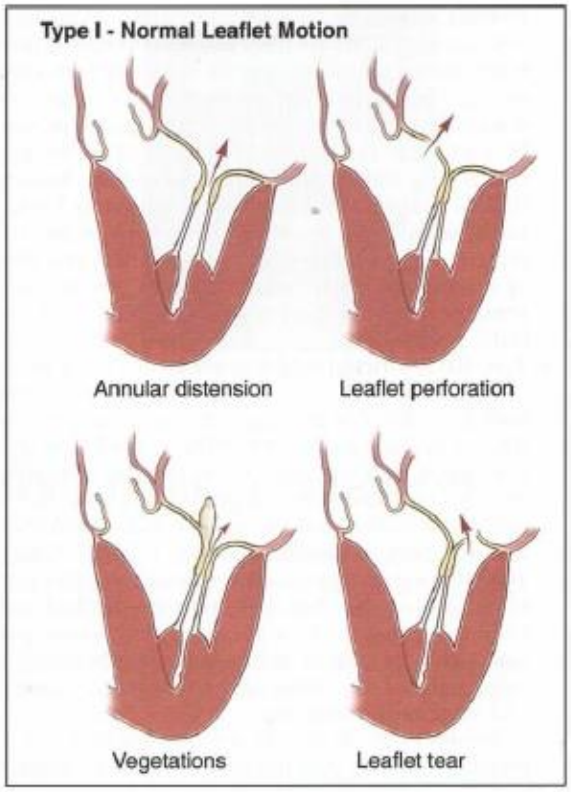

400
300
200
100
0
Ring
Quadrangular resection
Chord shortening
Chord transposition
PM shortening
Sliding leaflet
Physio ring
Congenital fibroelastic deficiency
Endocarditis
Rheumatic
Barlow
Ischemic
Calcified annulus
1970
1972
1974
1976
1978
1980
1972
1974
1976
1978
1990
1992
1994

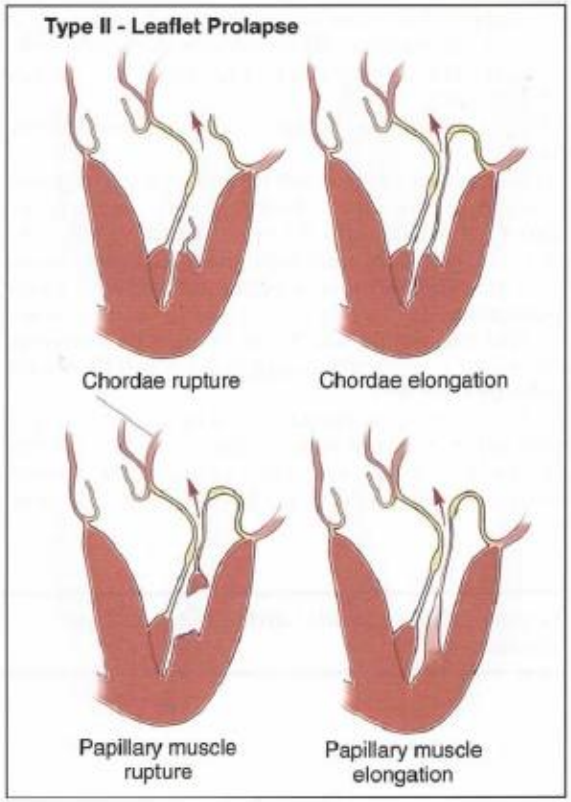
Reconstructive Valve Surgery
Three Fundamental Principles

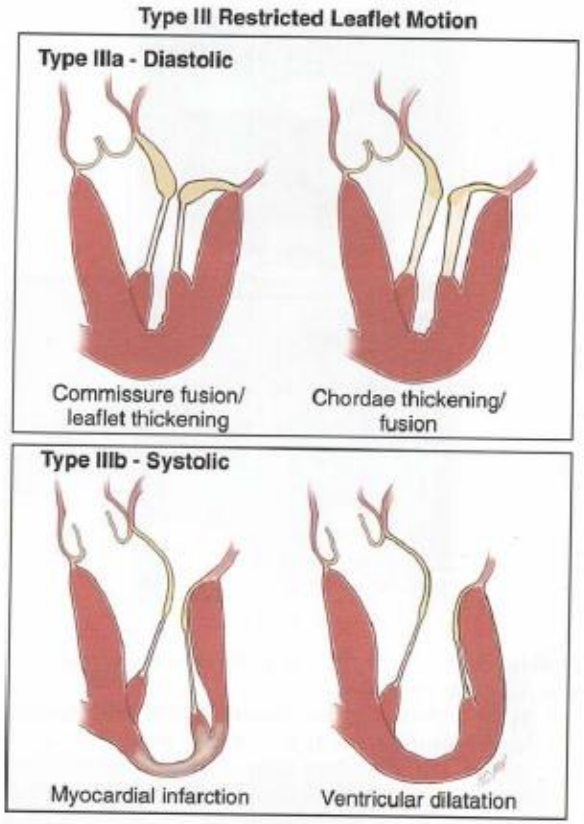
1. Preserve or restore full leaflet motion
2. Create large surface of coaptation
3. Remodel the annulus

A. Carpentier. JTCS 1983;86(3):323-37

Carpentier's Classification







Techniques of MV Repair

- **Ring annuloplasty**
- **Quadrangular/Triangular resection**
- **Sliding annuloplasty**
- **Chordae shortening / transposition / transfer**
- **Artificial chordoplasty**
- **Paracommissural obliteration / sliding**

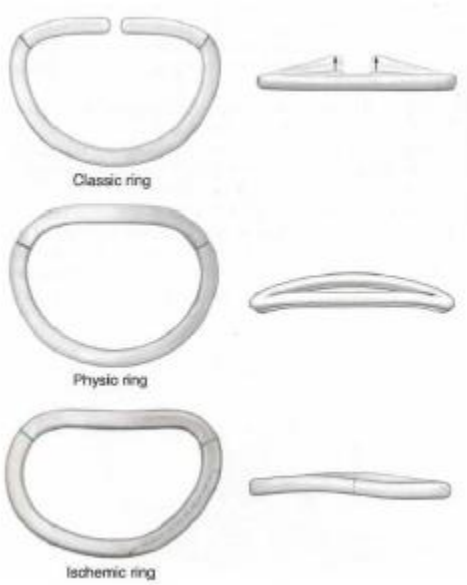
** ***One lesion, one technique!!***

Remodeling prosthetic ring

The remodeling ring restores the normal systolic shape and size of the annulus, a condition needed for optimal leaflet coaptation. It also prevents further deformation

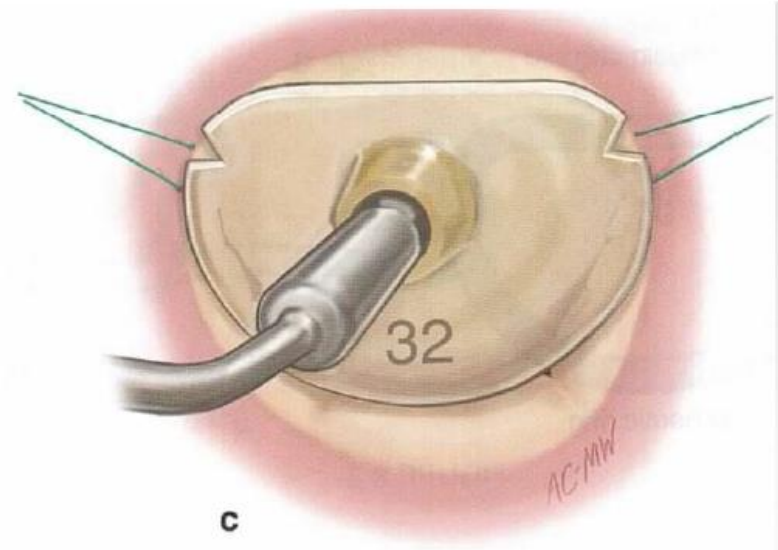
Annuloplasty ring

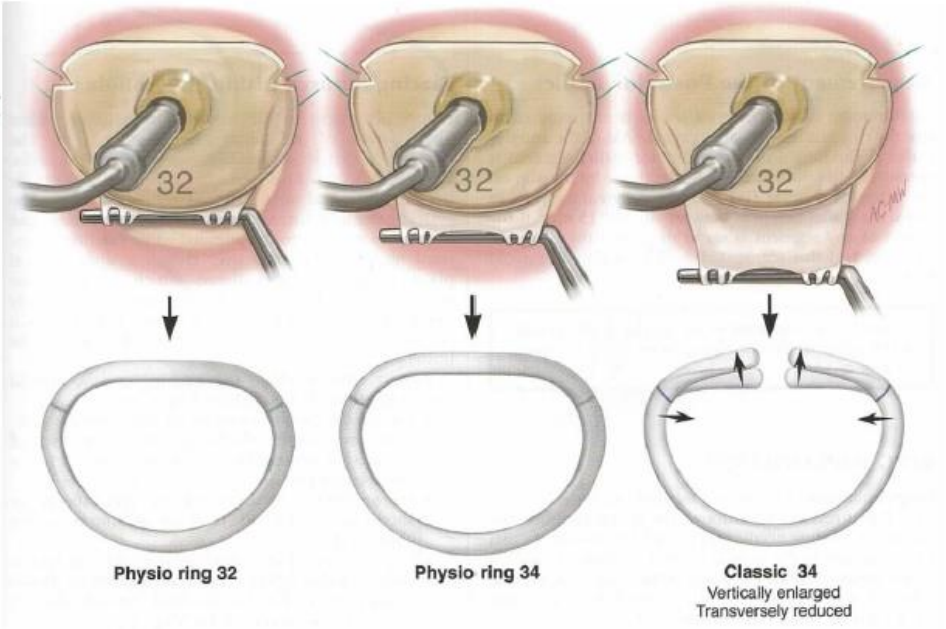
- Complete vs incomplete
  - Incomplete
    - Usually posterior annular dilatation
    - Leaflet repair itself reduce annular circumference
    - Difficult visualization of anterior annulus
  - Complete
    - Functional MR(to reduce annular circumference)
- Rigid, Semi-rigid, Flexible
  - Flexible ring
    - Physiologic movement of MV annulus
    - Valve distorsion or orifice narrowing
  - Rigid ring : more prone to produce SAM
- Adjustable vs fixed



Ring sizing

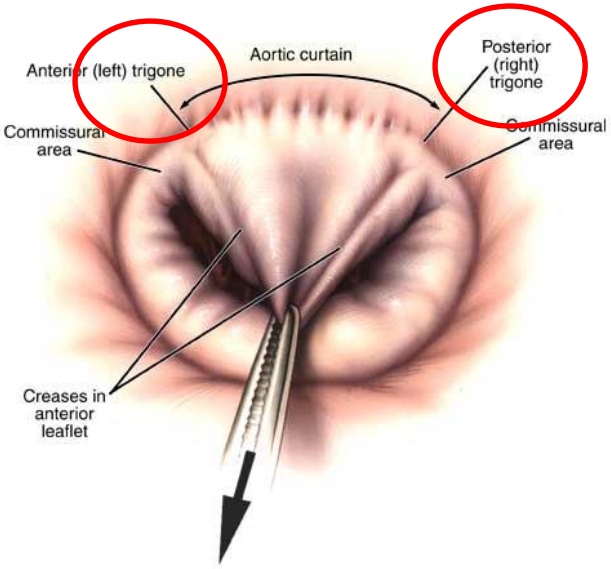
- Measurement of anterior leaflet
- Commissure to commissure
- Height of anterior leaflet

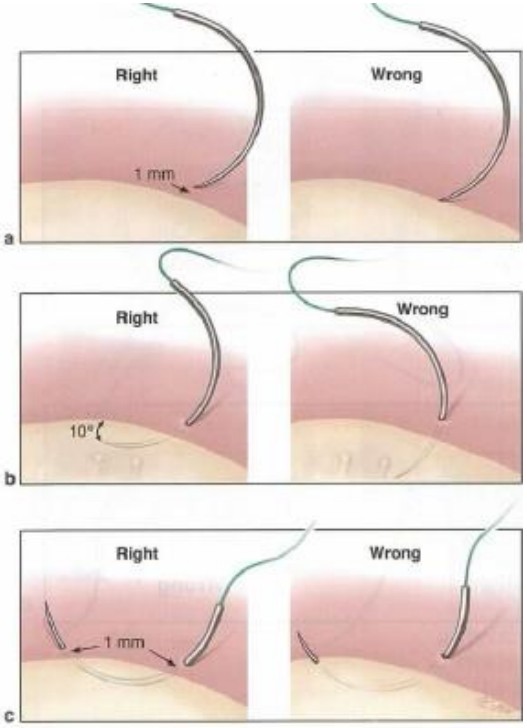


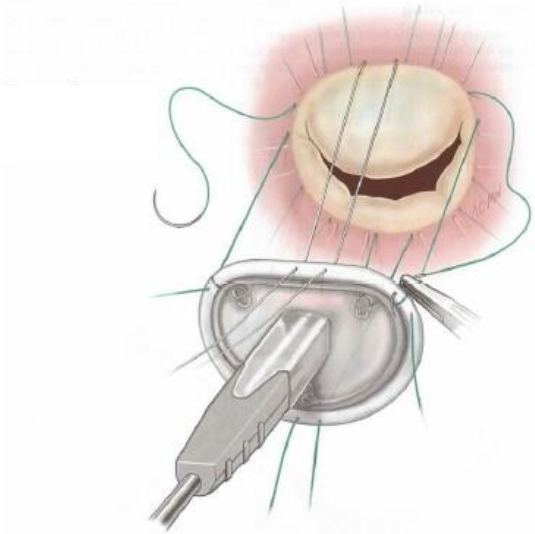


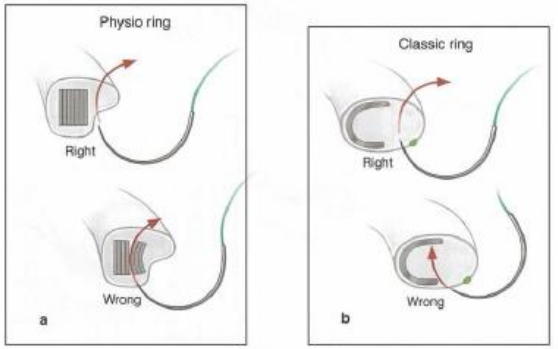
Annuloplasty suture

- Suture within the annulus fibrosus
  - to avoid ring dehiscence
- Not to suture metallic core of ring
  - to avoid annular distorsion





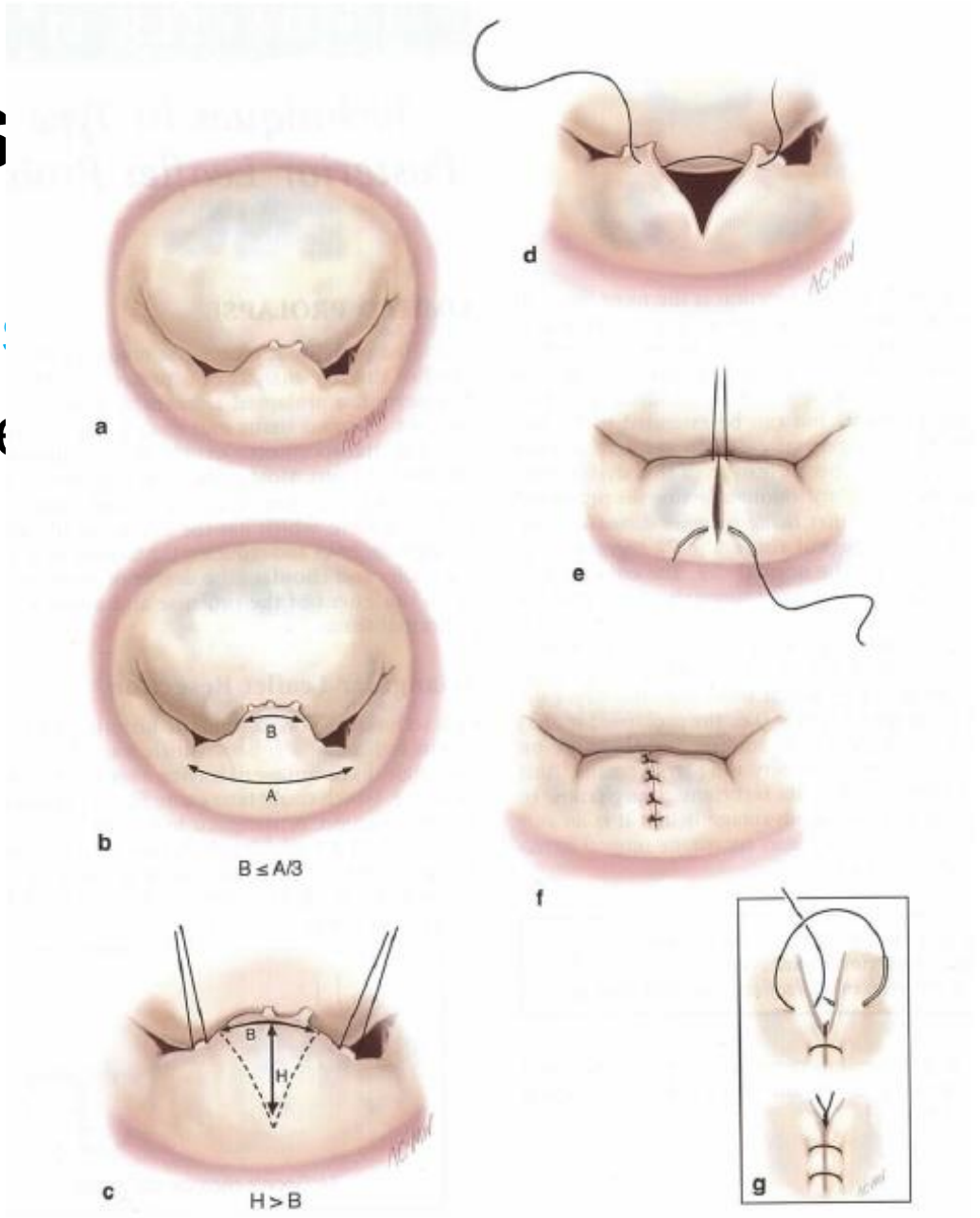




Pos

- **Triangular re**

  : <1/3 of segme

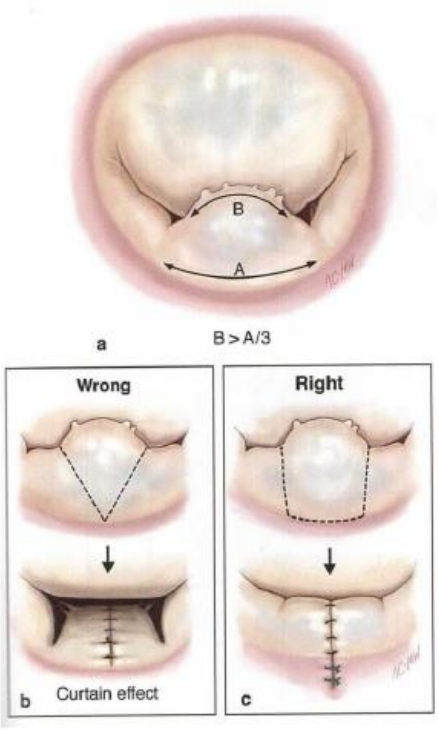


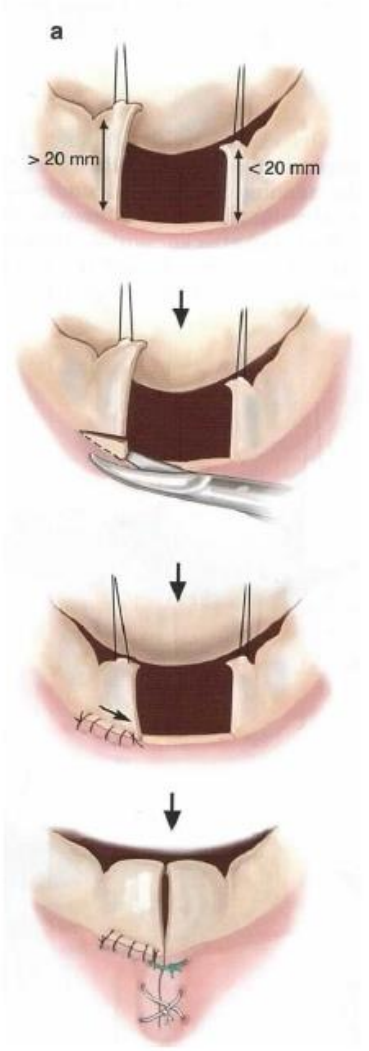
Posterior prolapse

- **Quadrangular resection**

  : >1/3 of segment

  Annular plication





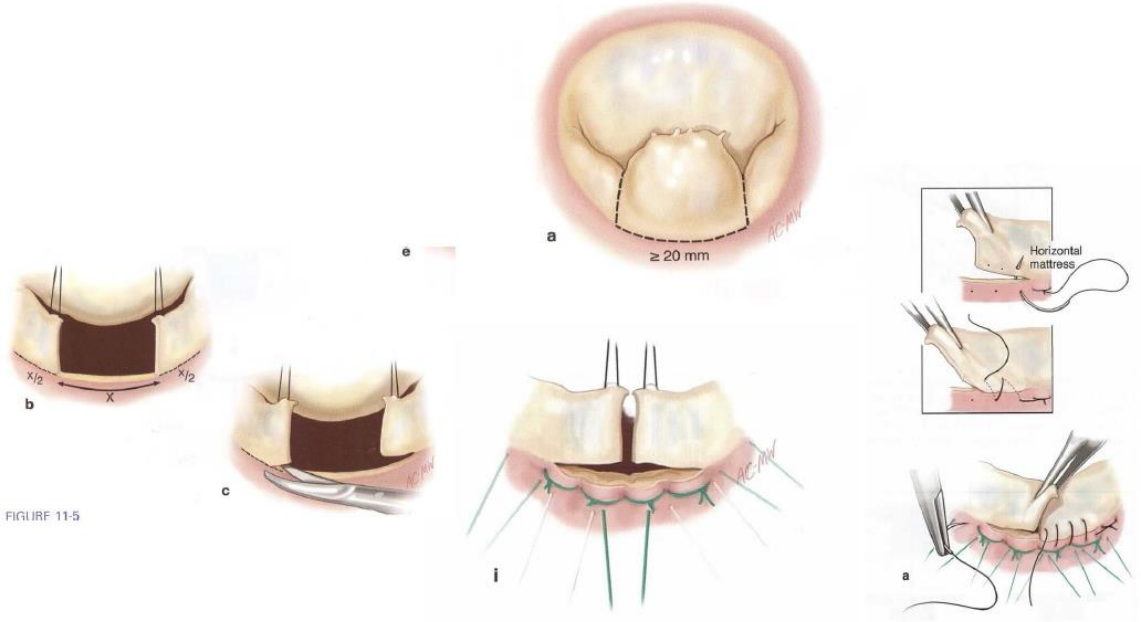
Posterior prolapse

- **Quadrangular resection+sliding annuloplasty**

  : >30mm

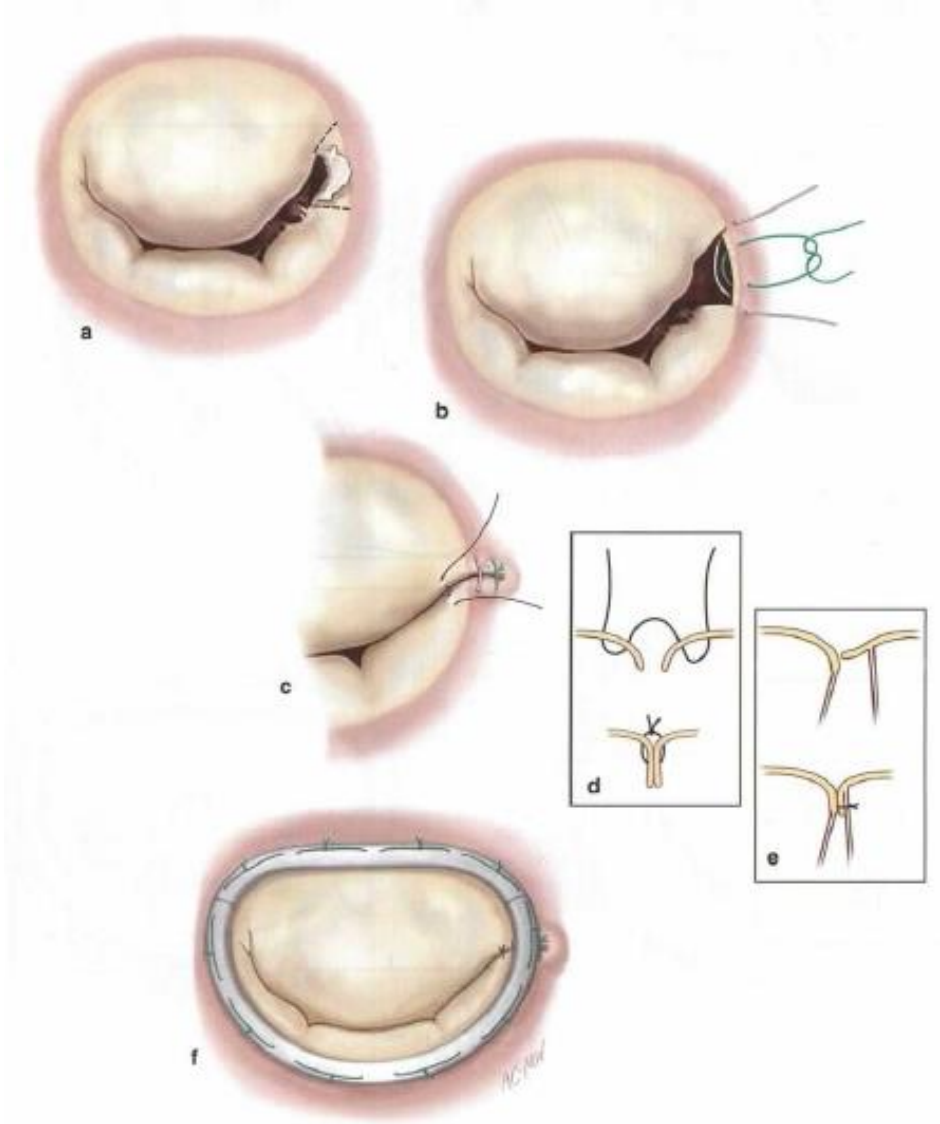
  Prevent SAM

  Compression suture



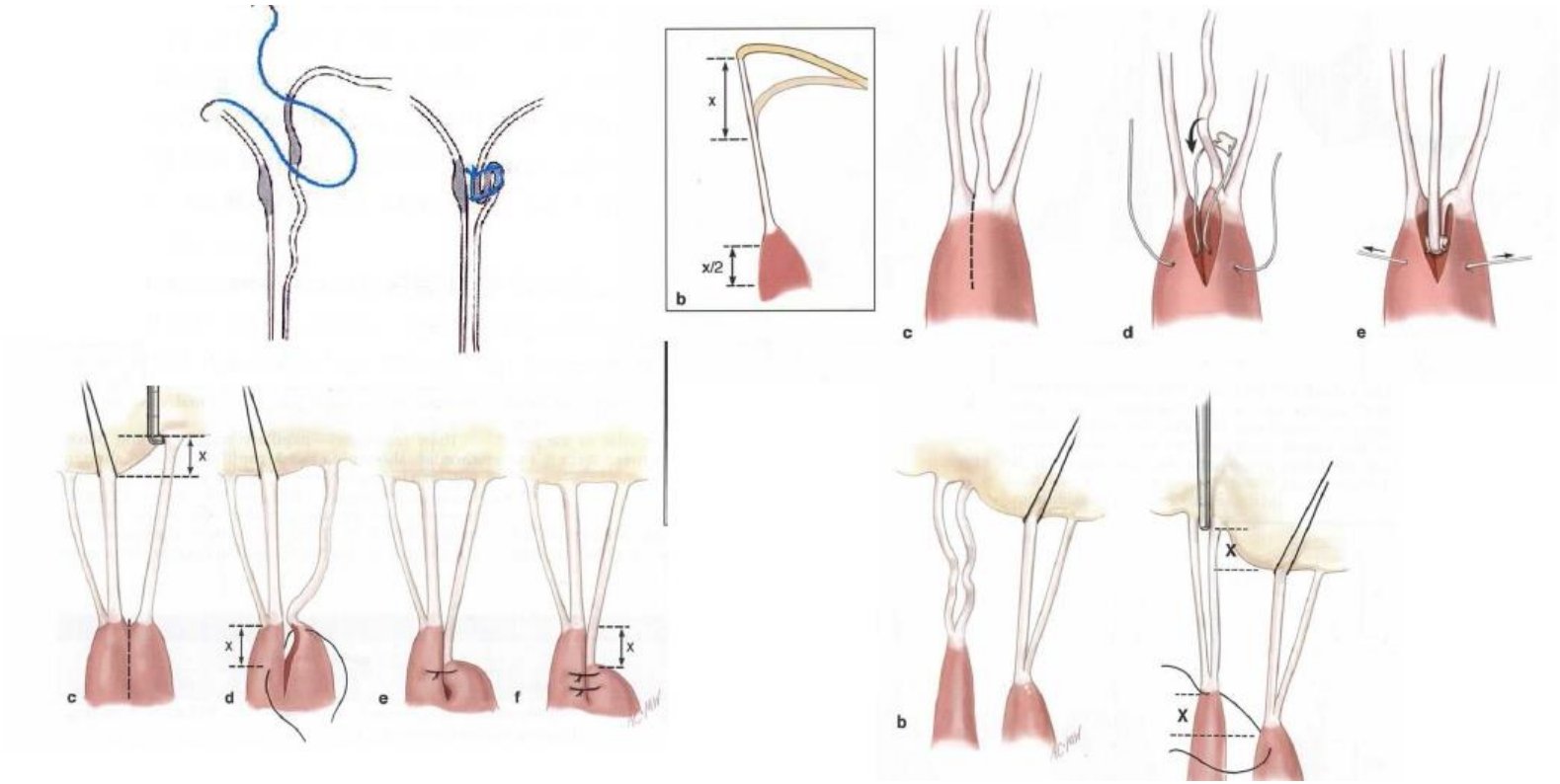
Commissural prolapse

- Commissural plication
- Triangular resection



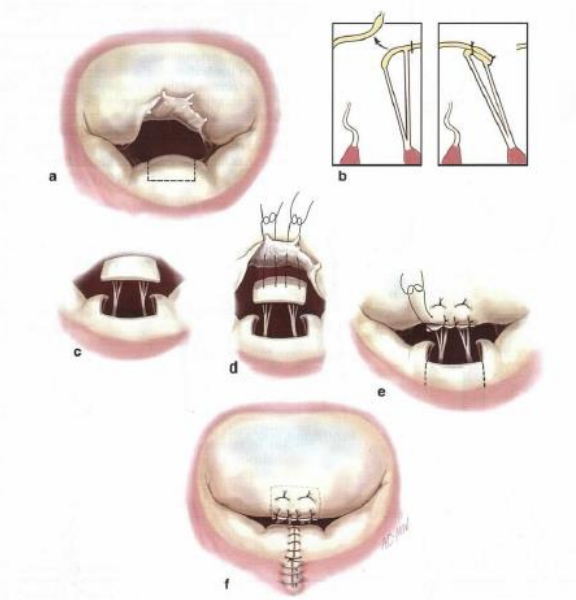
Anterior prolapse

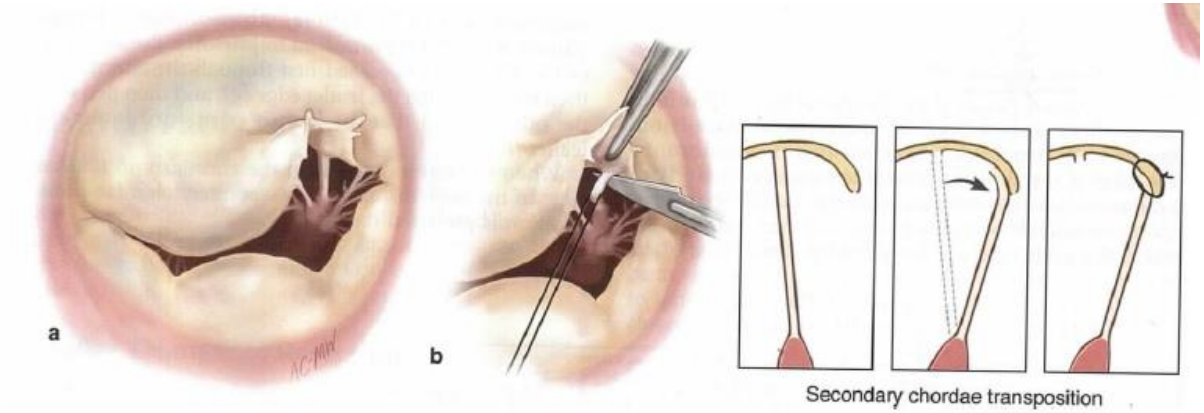
- Chordae shortening
- Papillary muscle sliding plasty



Anterior prolapse

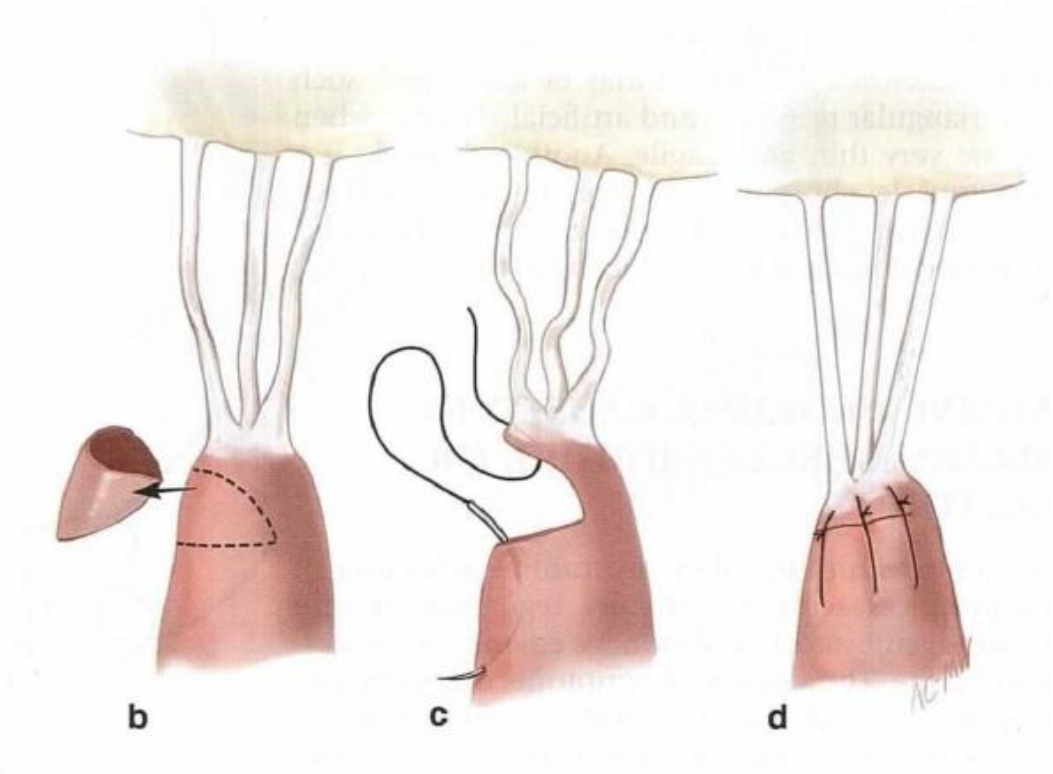
- Chordae transfer
  - 2ndary chordae
  - Posterior chordae





Anterior prolapse

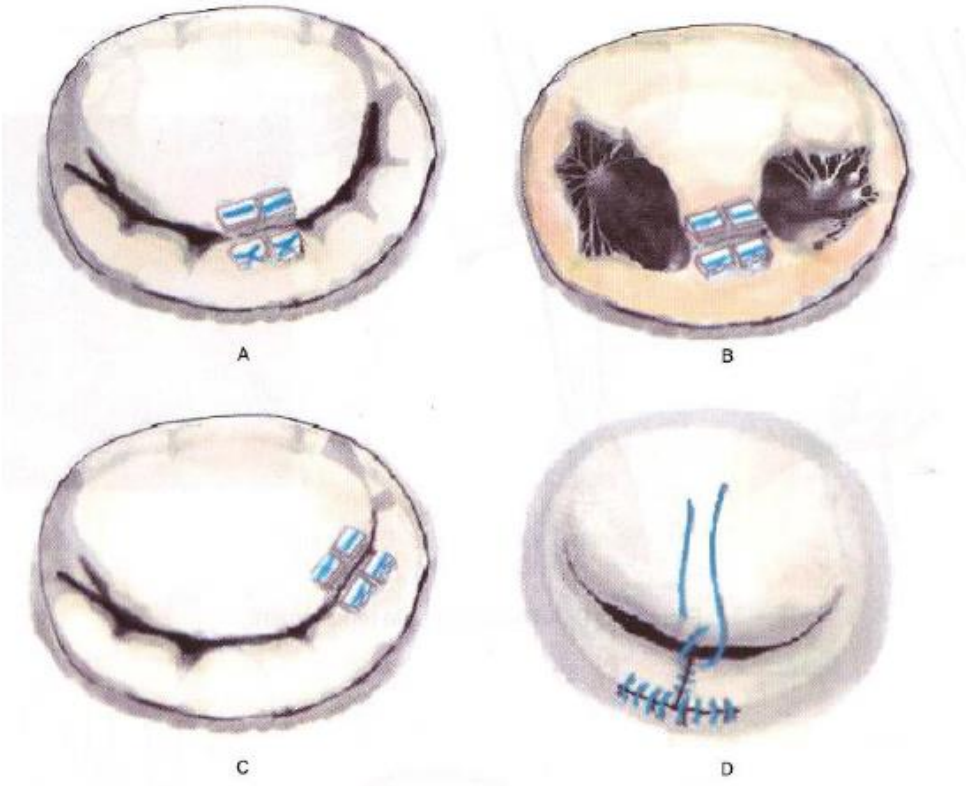
- Papillary muscle shortening



Anterior prolapse

- Alfieri(double orifice) technique

  : not to make stenosis



Anterior prolapse

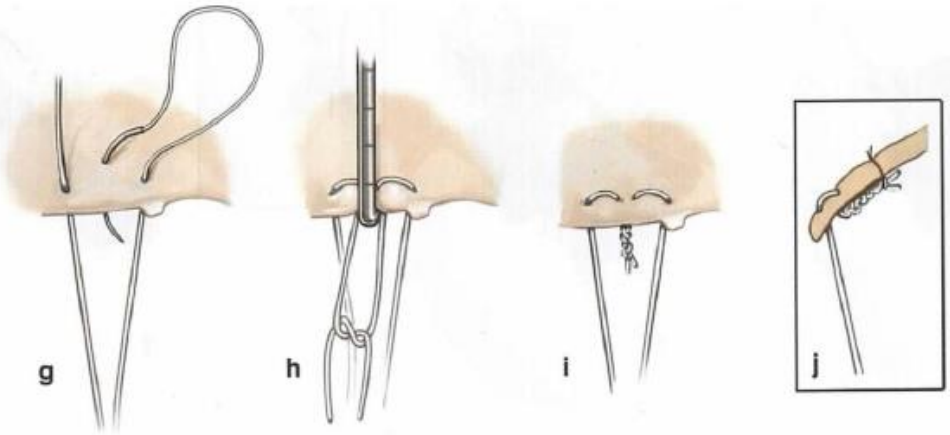
- Chordae shortening
- Papillary muscle shortening
- Papillary muscle sliding
- Papillary muscle trenching
  → technically difficult, not reproducible..

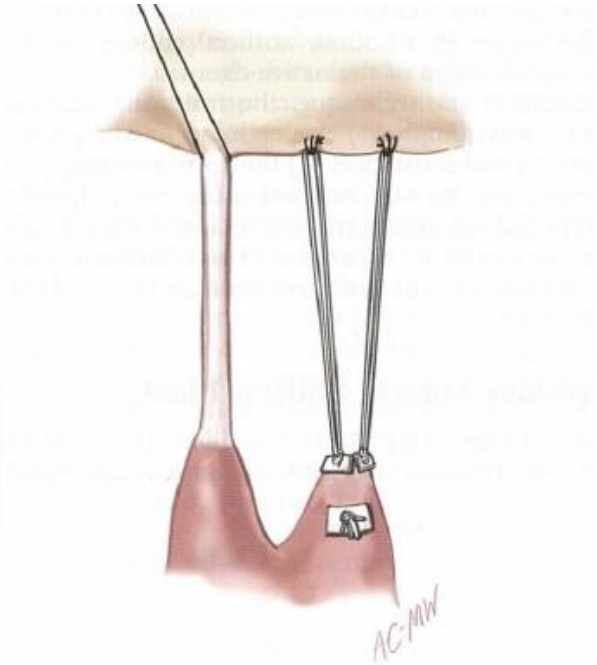
- Long-term results : **posterior**>>anterior

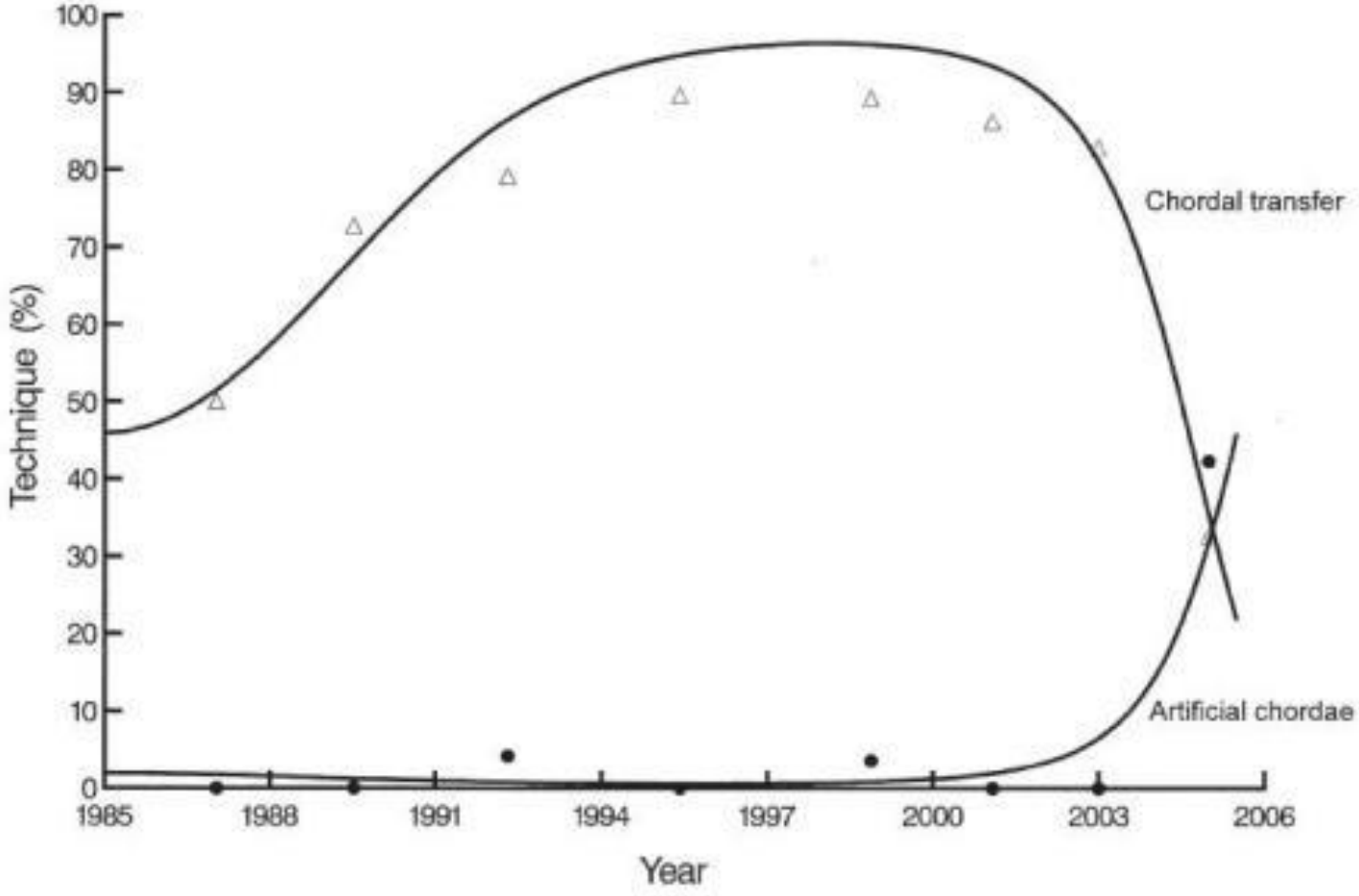
✓ **Artificial chordae implantation**

Anterior prolapse

- **Artificial chordae implantation**



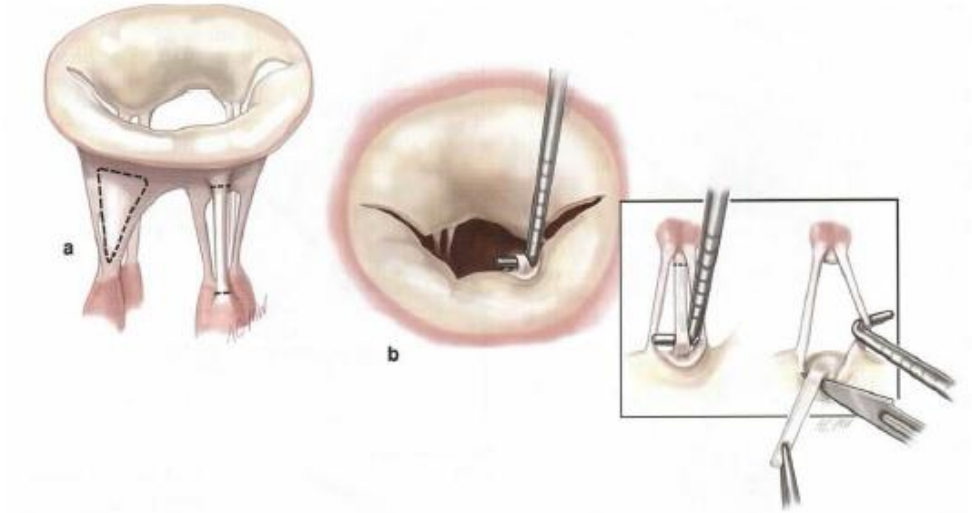


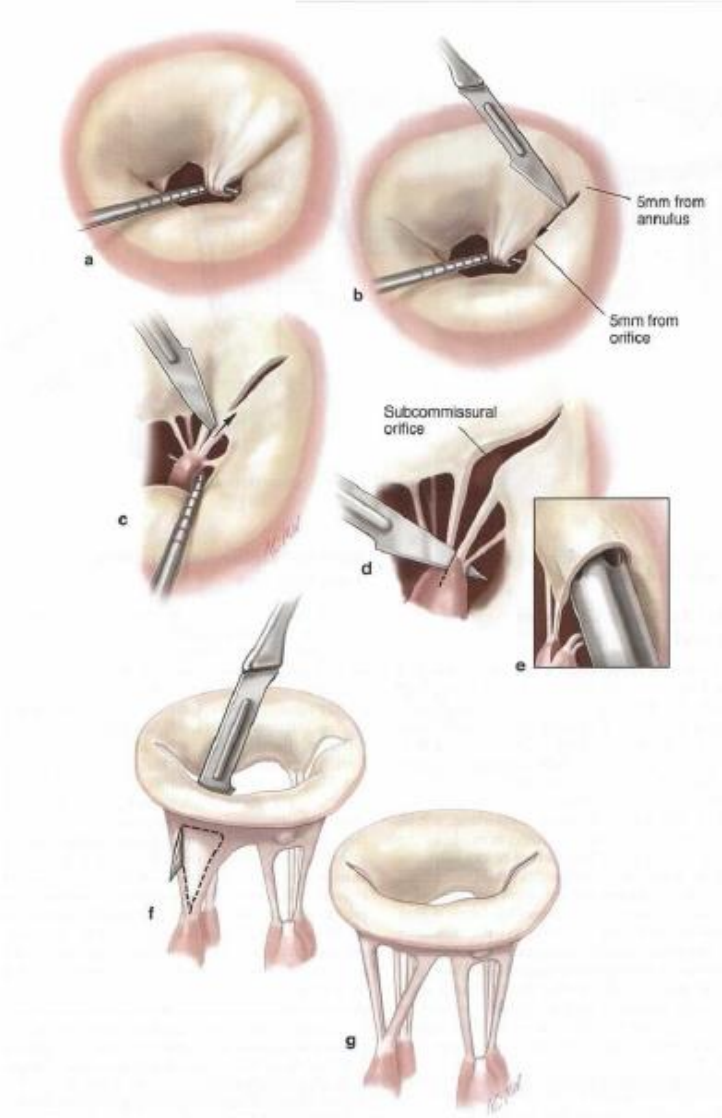

100
90
80
70
60
50
40
30
20
10
0
Technique (%)
1985
1988
1991
1994
1997
2000
2003
2006
Year
Chordal transfer
Artificial chordae

Rheumatic MV disease

- Commissurotomy
- 2ndary chordae resection
- Not good result

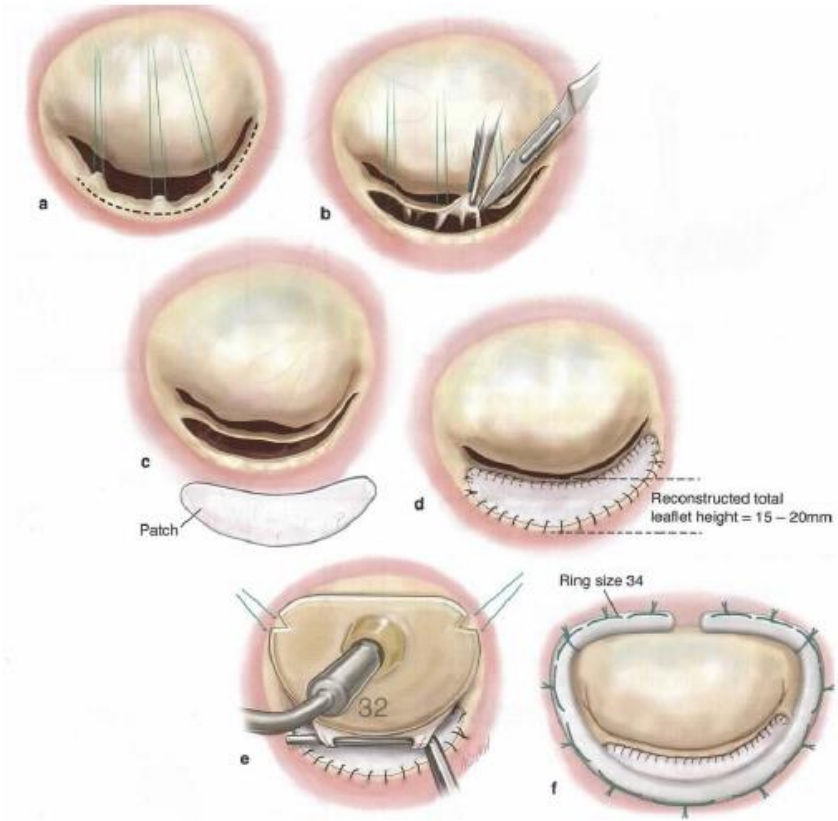
  in severe deformity valve

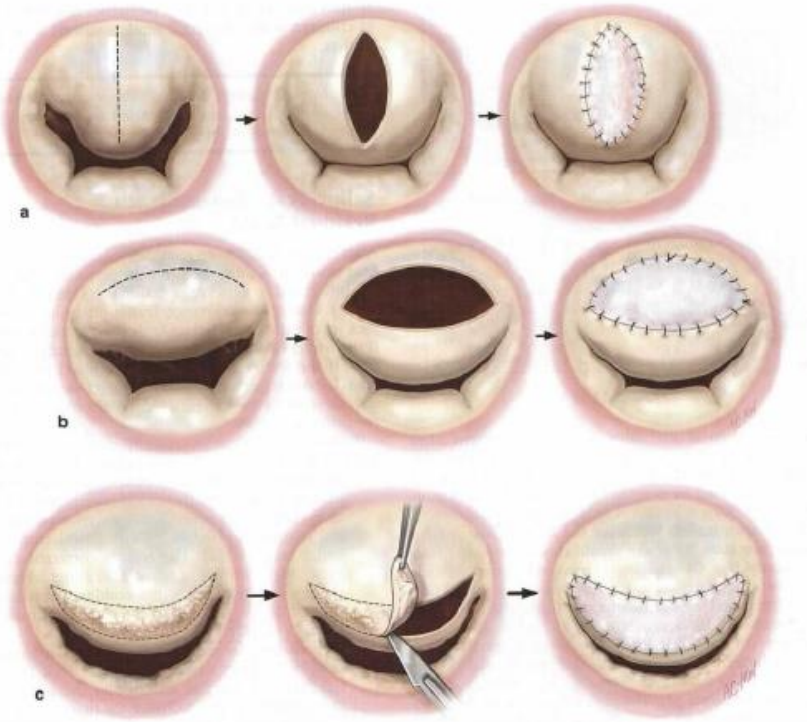




Rheumatic MV disease

- Leaflet extension : pericardium

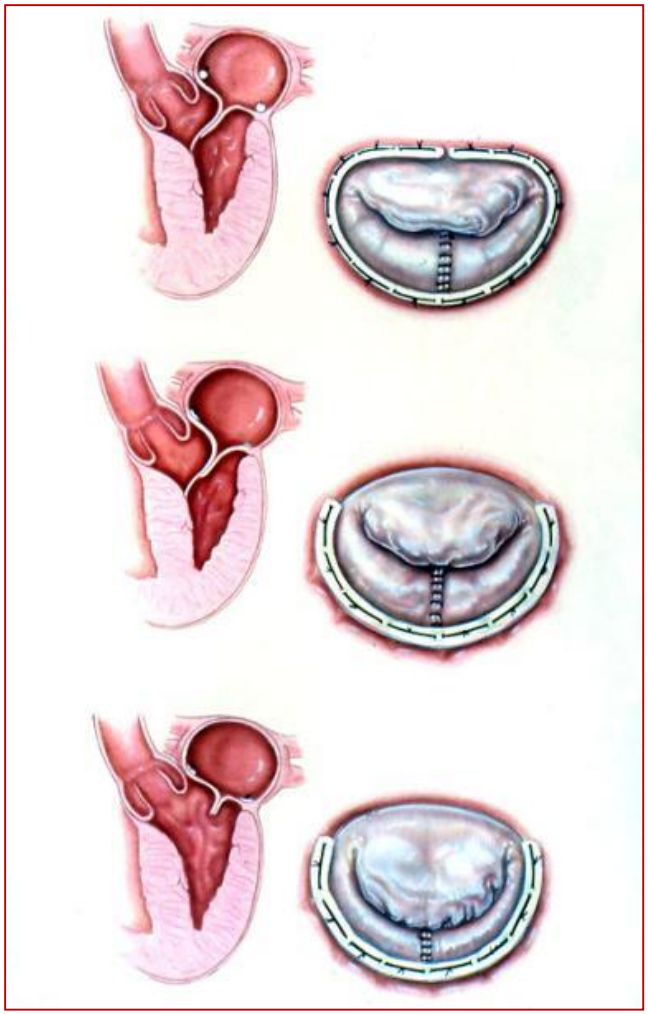




SAM(Systolic anterior motion)

- 2-5% in annuloplasty

- Risk factors
  - **Excess valvular tissue**
  - **Undersized annuloplasty**
  - Narrow aorto-mitral angle
  - Hyperkinetic small ventricle
  - Septum bulging



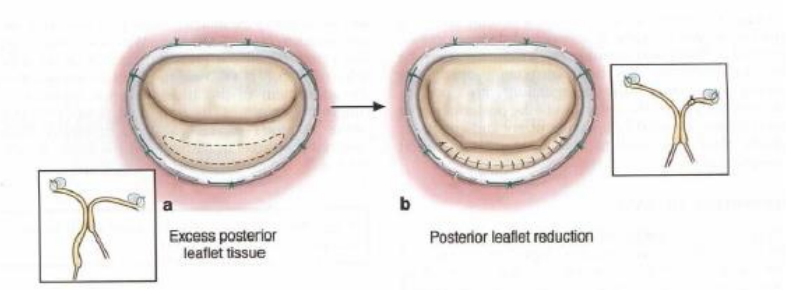
SAM(Systolic anterior motion)

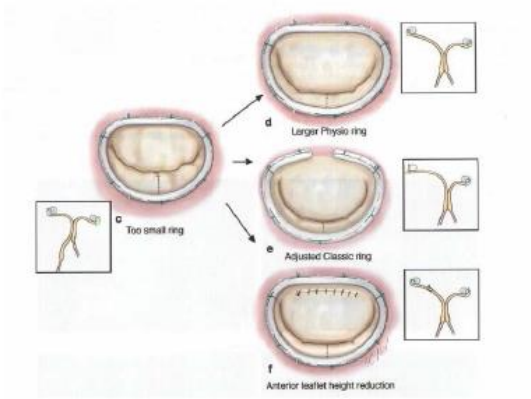
- Cause(Intraoperative)
  - Hypotension
  - Hypovolemia
  - Small ventricular cavity
  - Ventricular hypertrophy
  - Hyperdynamic state

- Treatment
  - Withdrwal of inotropics
  - Volume loading
  - Slowing heart rate
  - Increased afterload
  - Reop

SAM - repair technique

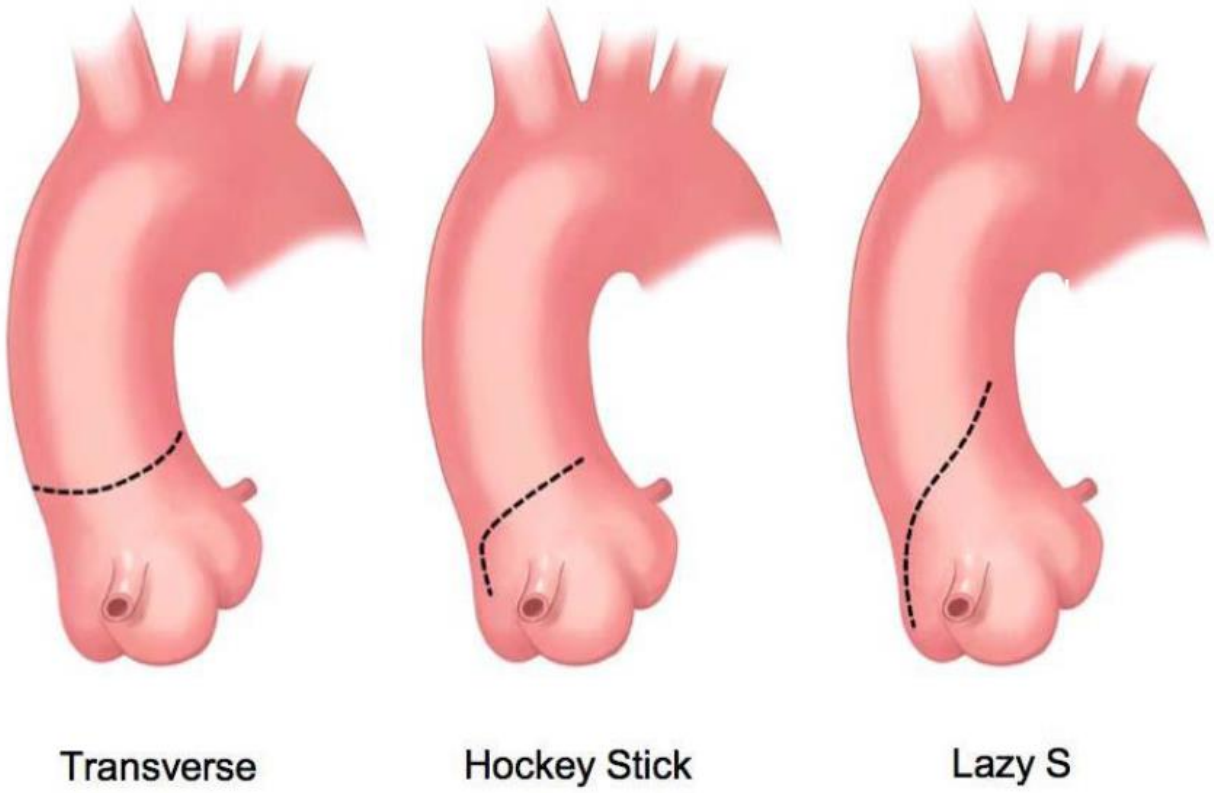
- Larger annuloplasty ring
  - Band >> complete ring
  - Flexible >> rigid ring
- Sliding annuloplasty:
  posterior leaflet height ↓
- Pomeroy procedure: ant. leaflet resection
- Transaortic septal myectomy

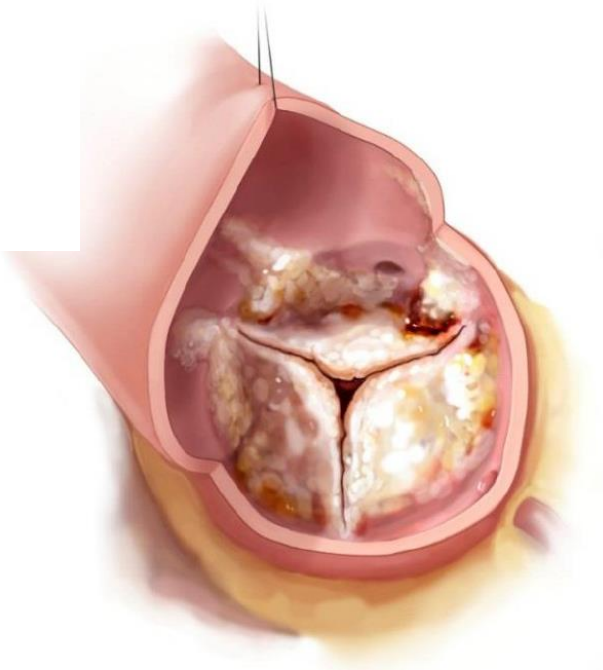


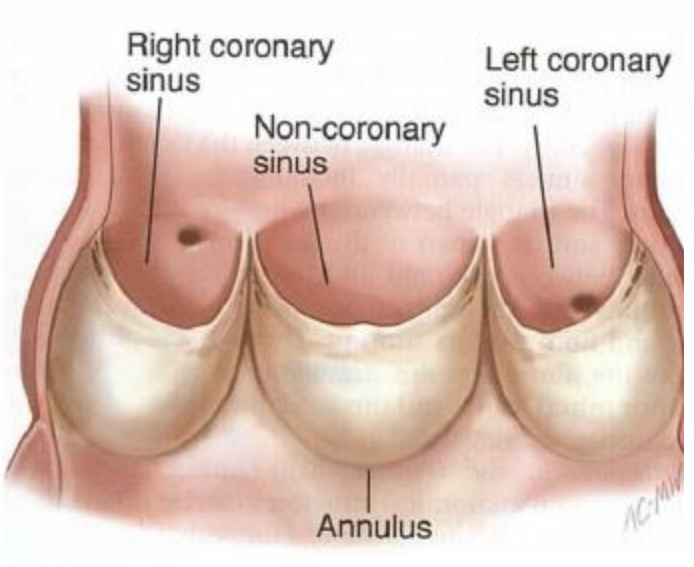


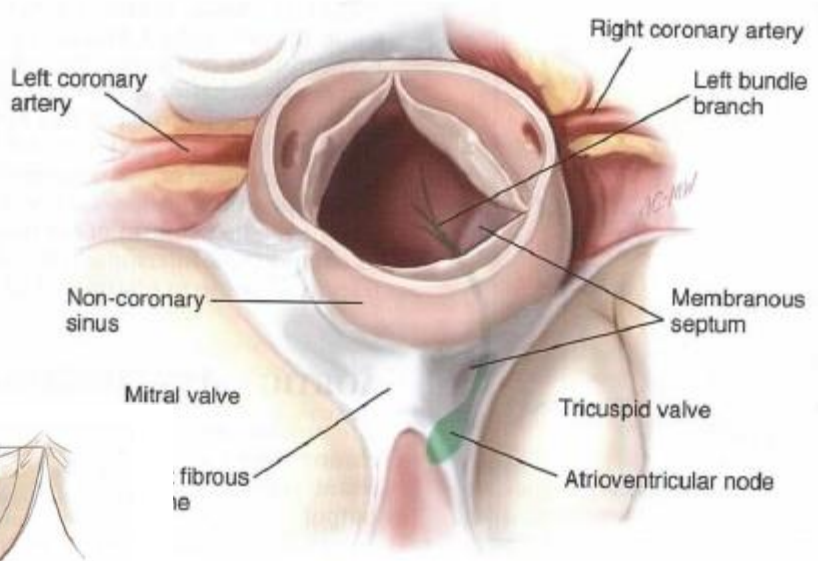
Aortic valve replacement

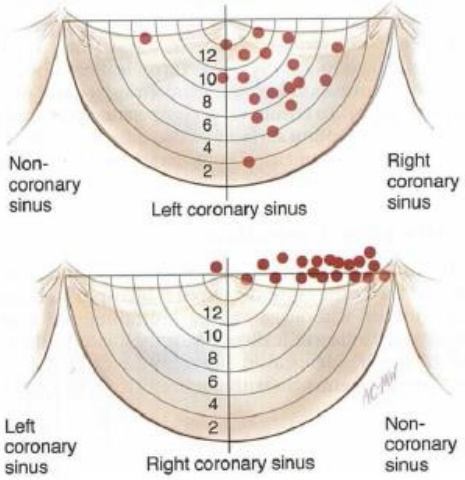
Aortic valve exposure !!!!!!



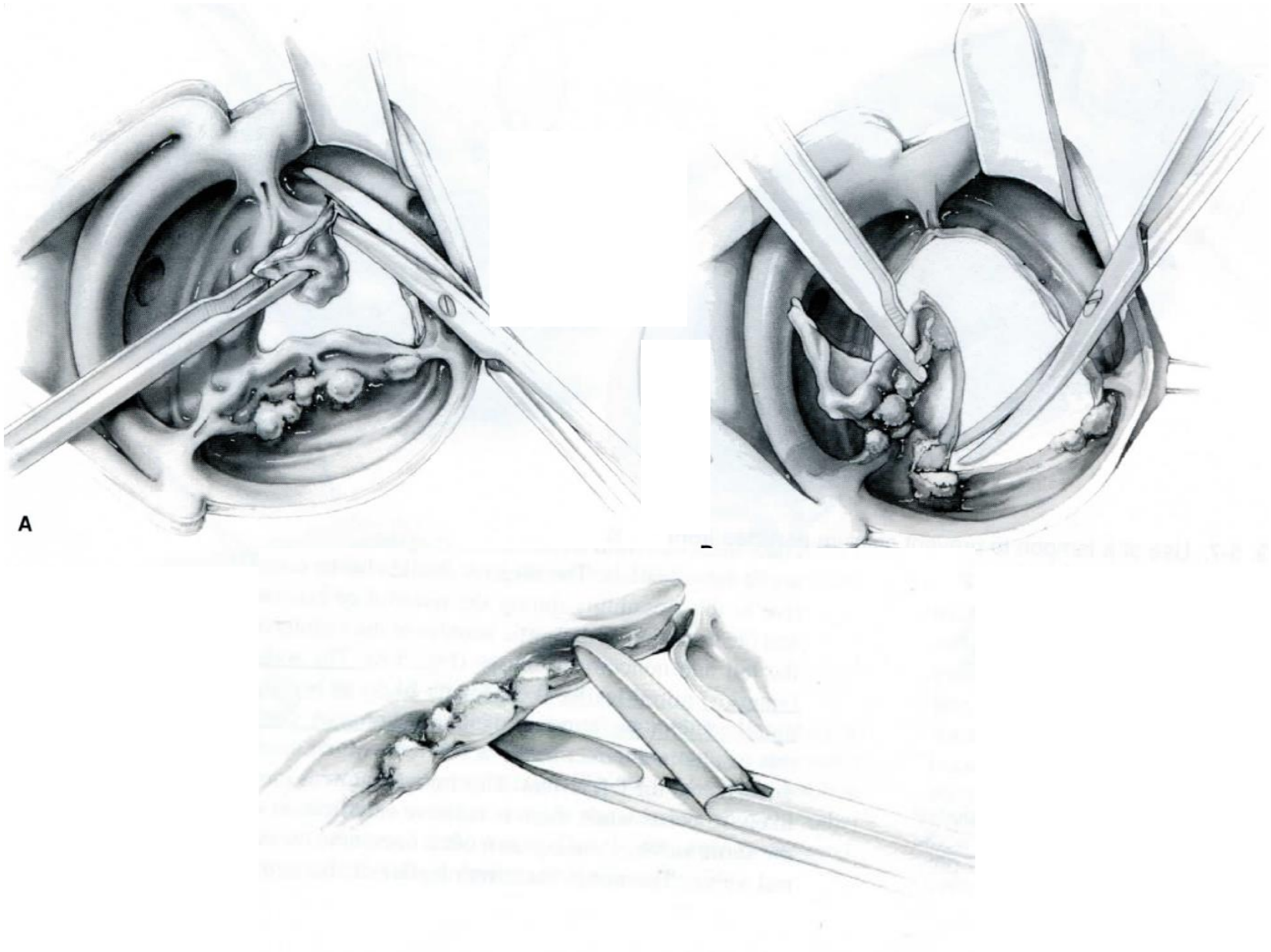



Right coronary sinus
Non-coronary sinus
Left coronary sinus
Annulus

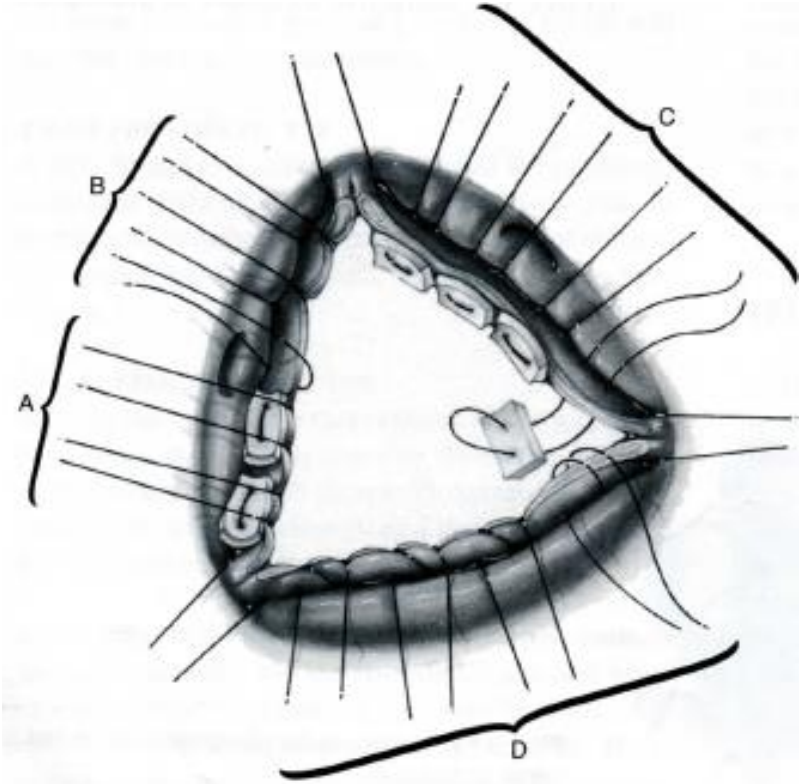

Right coronary artery
Left coronary artery
Left bundle branch
Non-coronary sinus
Membranous septum
Mitral valve
Tricuspid valve
fibrous
Atrioventricular node

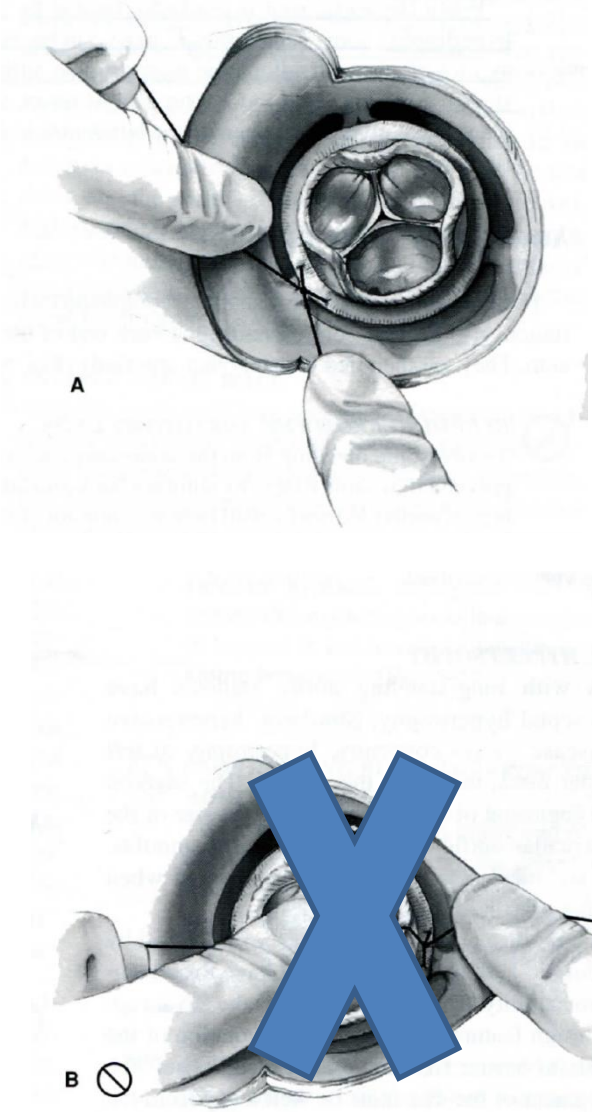

12
10
8
6
4
2
Non-coronary sinus
Left coronary sinus
Right coronary sinus
12
10
8
6
4
2
Left coronary sinus
Right coronary sinus
Non-coronary sinus

Aortic valve excision



Valve suture insertion

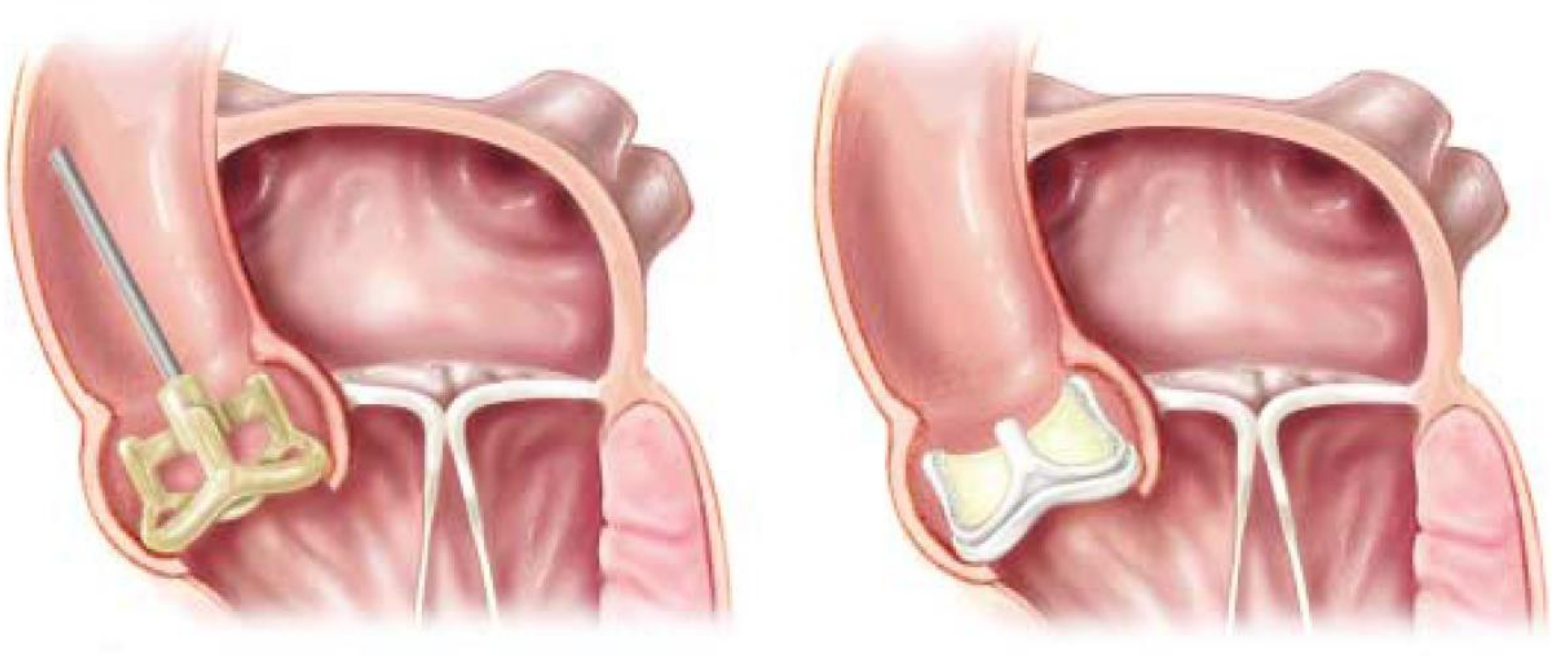




Aortic Valve replacement

Supra-annular

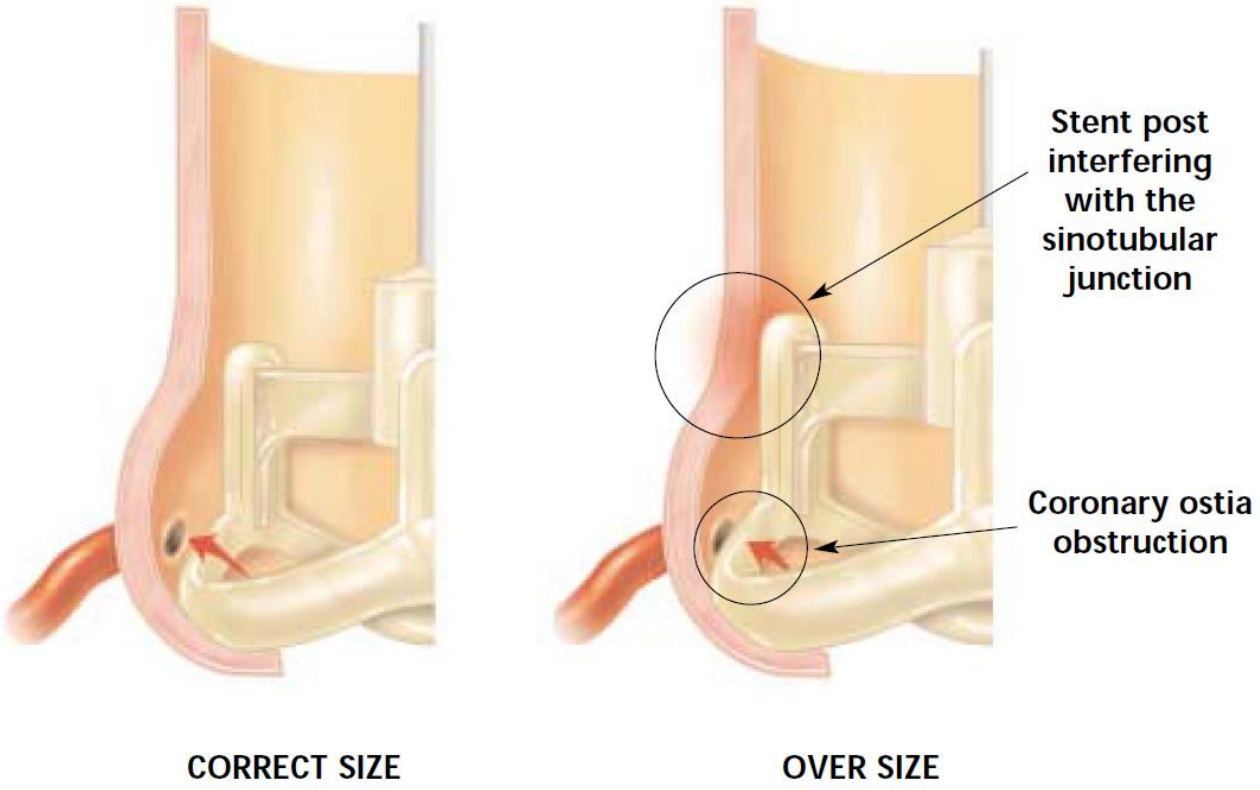
Sizing



Aortic Valve replacement

Supra-annular

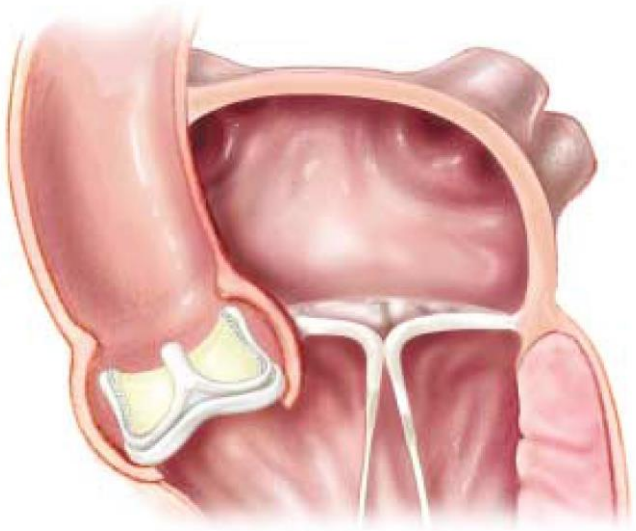
Sizing



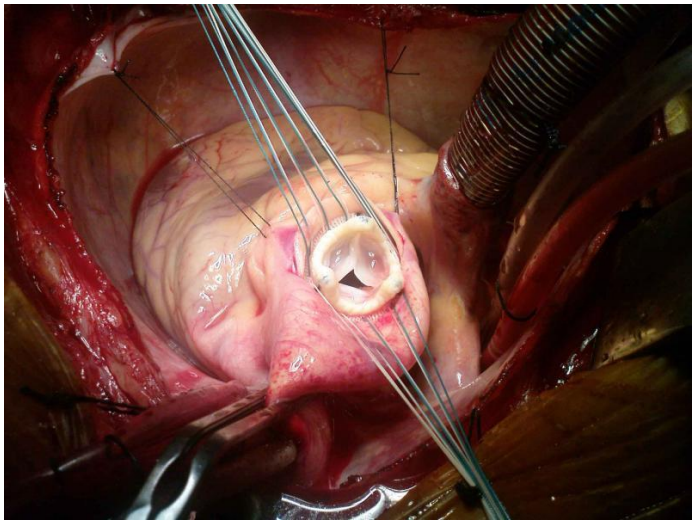
Supra-annular

Implantation technique

Non-everting mattress suture



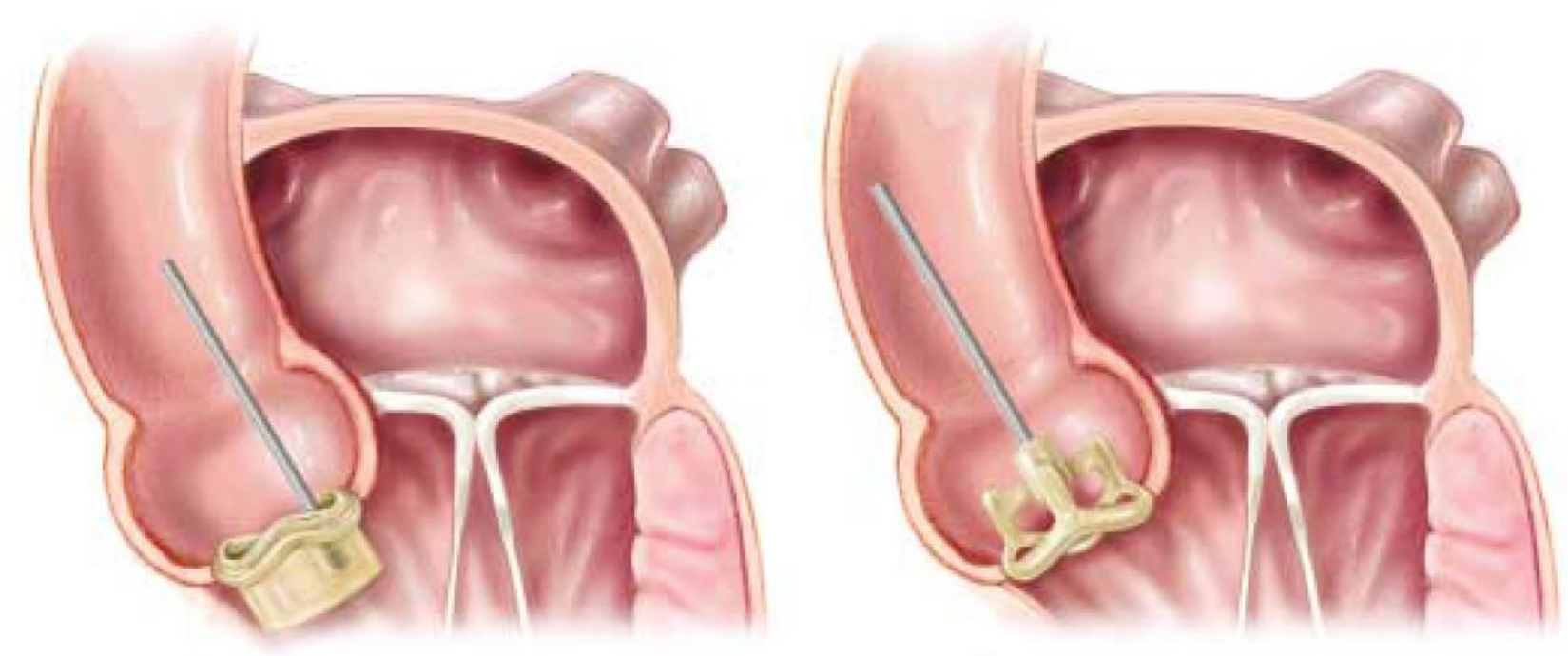
Supra-annular placement
of the Magna valve



Aortic Valve replacement

Intra-annular

Sizing

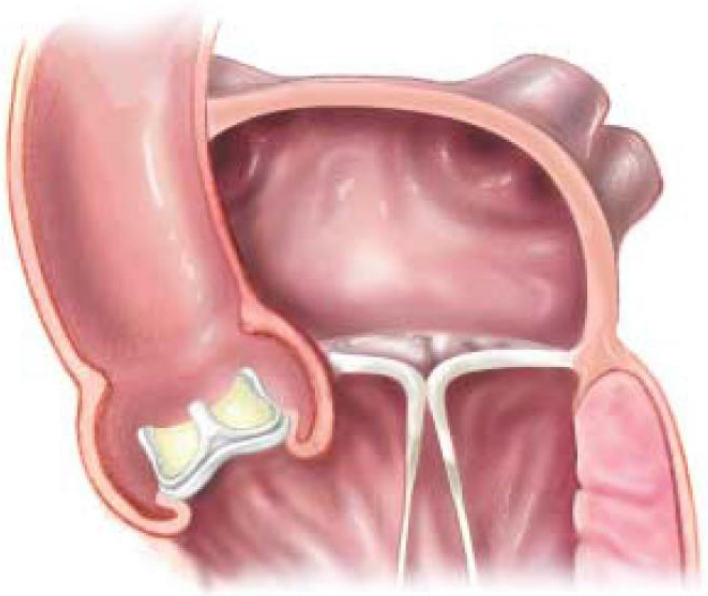


Aortic Valve replacement

Intra-annular

Implantation technique

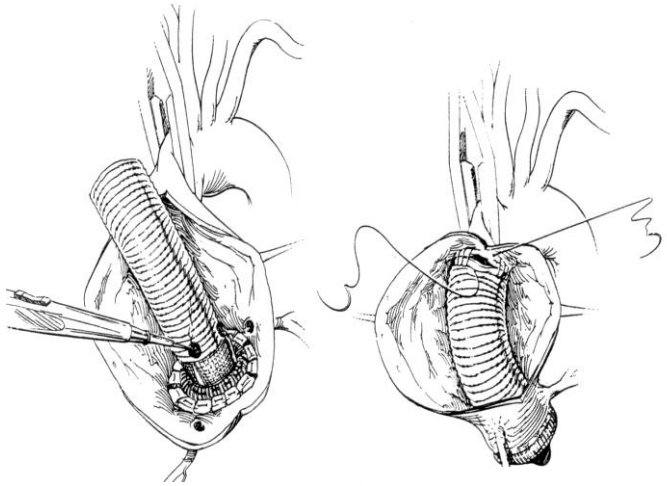
Everting mattress suture



Intra-annular placement
of the Magna valve

Patients & method

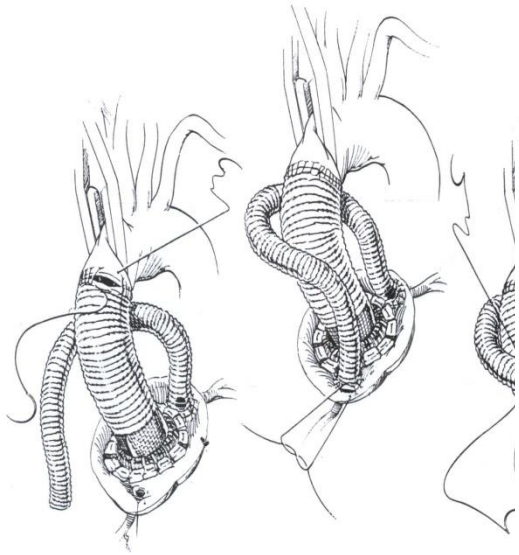
- Composite valve graft replacement
  (aortic root diseases)
  - **Classic Bentall technique**
  - **Cabrol technique**
  - **Button technique……**

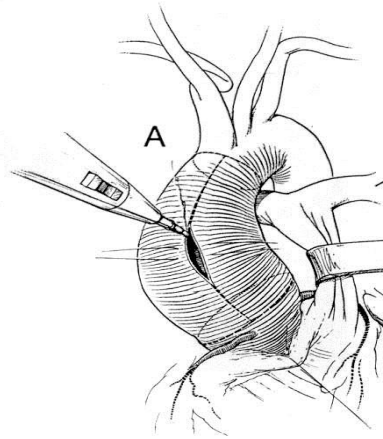


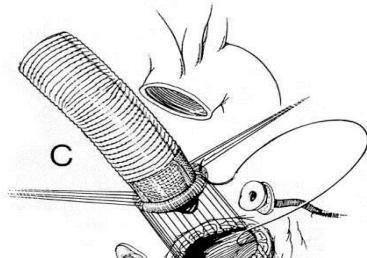
- ***Cabrol technique in KNUH***

✓ 1994. 1. ~ 2006.12 (N = 25)

✓ Mean follow-up periods
: 60.7±50.4 months (1-162 mont

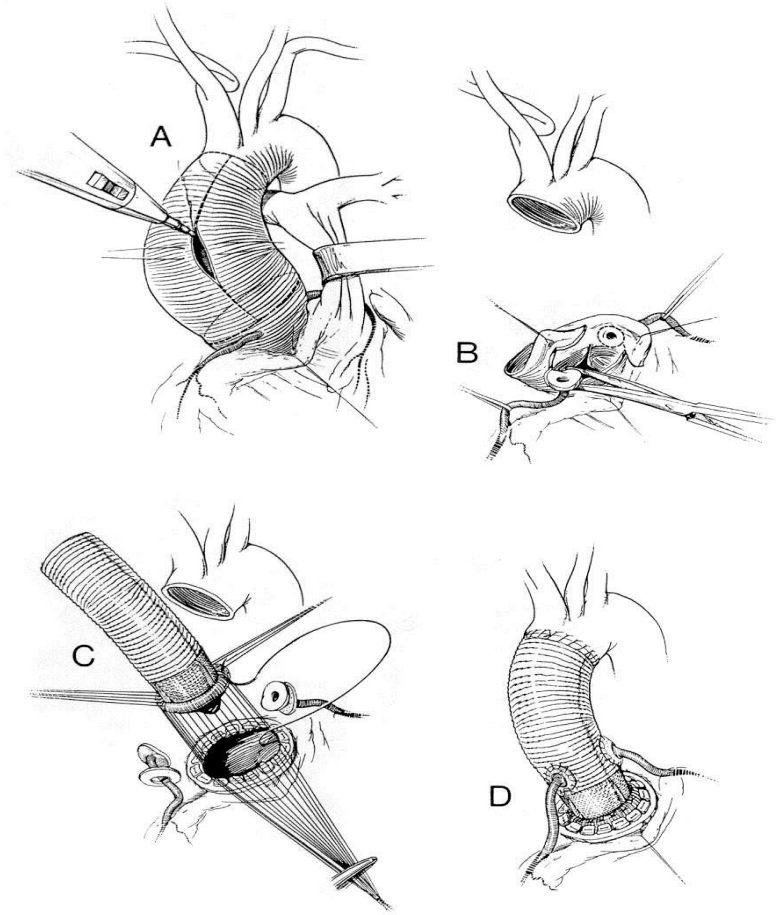




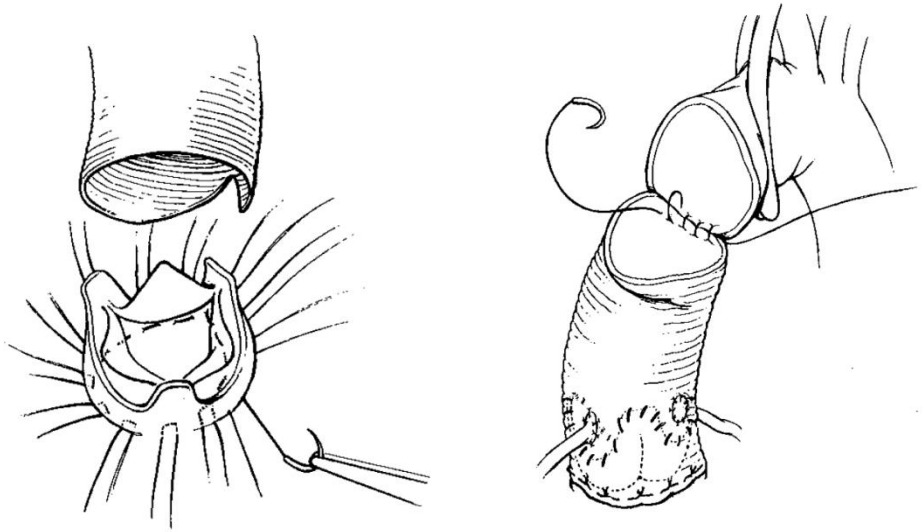


Aortic root disease

Modified Bentall operation
(Button technique)



Valve sparing operation
(David op)

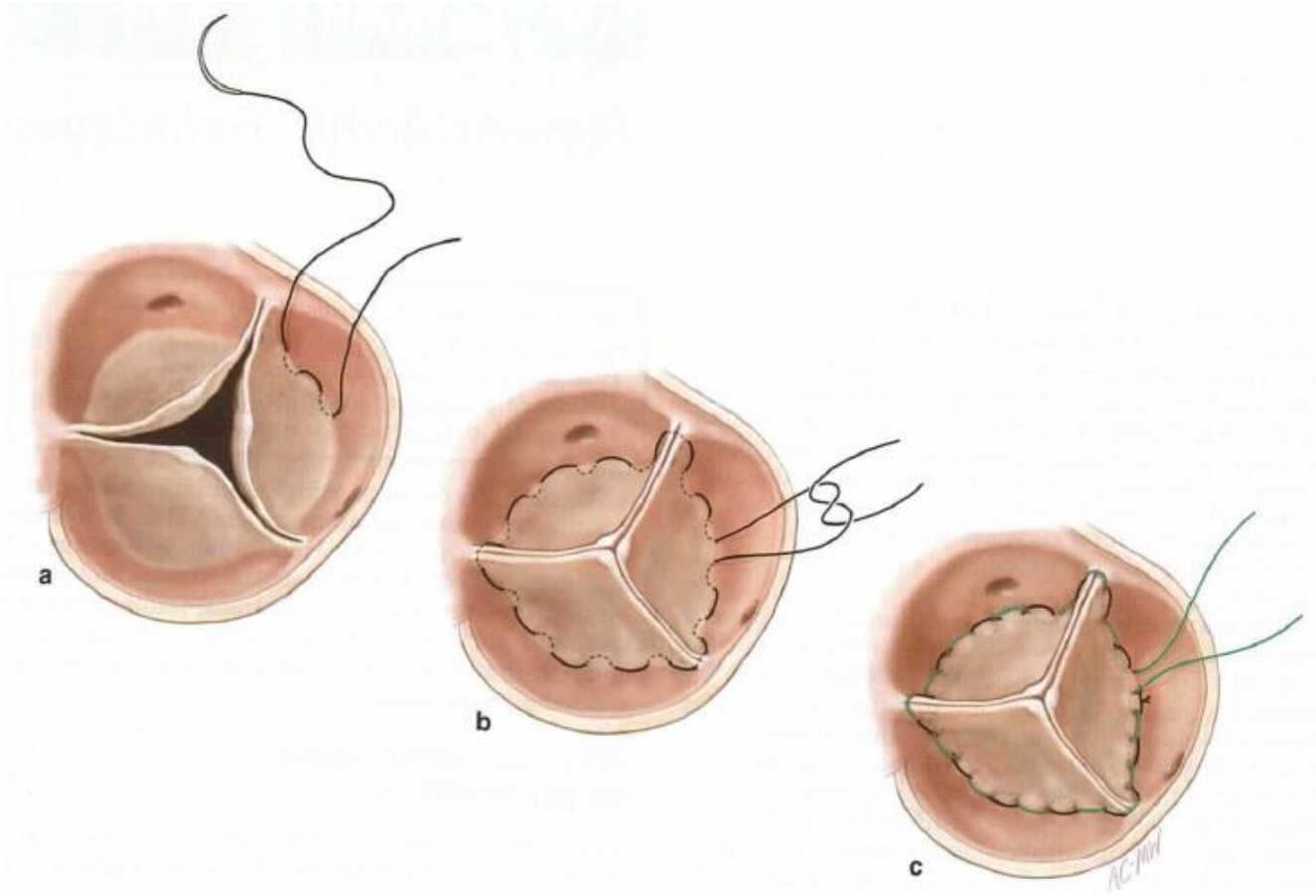


Sutureless valve

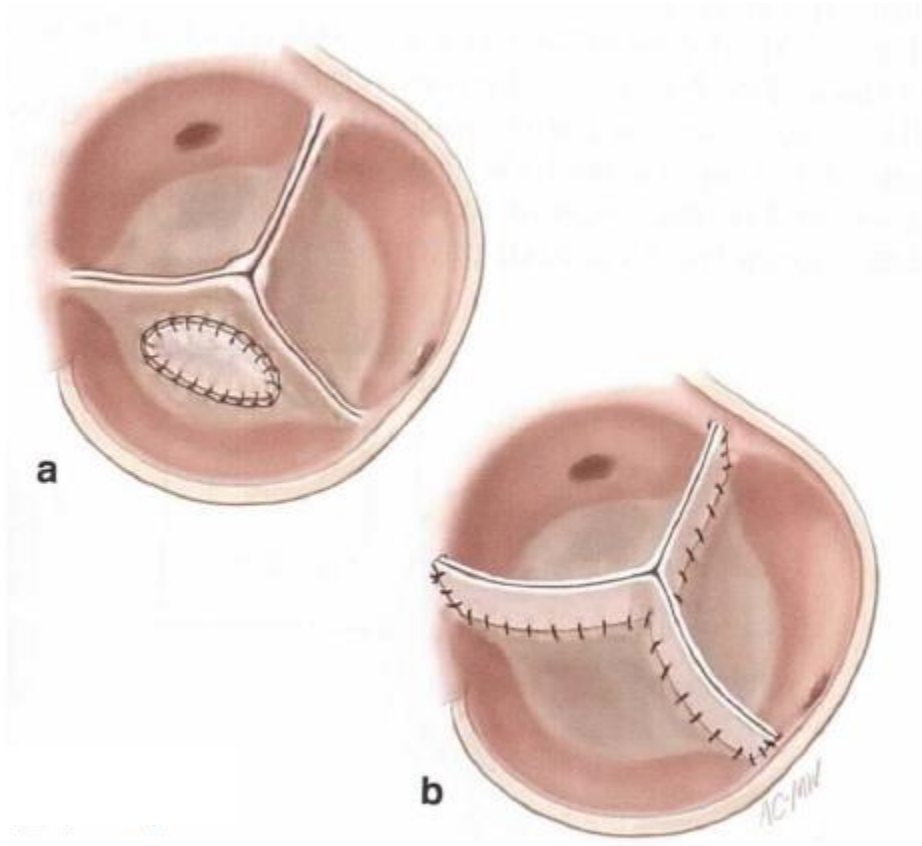
	EDWARDS INTUITY	Perceval S	3F Enable
			
TISSUE	Bovine Pericardium	Bovine Pericardium	Equine Pericardium
VALVE PREPARATION	No change	Crimped	Folded/crimped
FRAME MATERIAL	Stainless steel	Nitinol	Nitinol
ANTICALCIFICATION TREATMENT	Yes	Yes	No
POSITIONING	Rapid deployment	Self-anchoring	Sutureless
CE-MARK	Feb 2012	Jan 2011	Dec 2009
SIZE RANGE	19, 21, 23, 25, 27mm	S, M, L, XL	19, 21, 23, 25, 27, 29mm
# OF GUIDING SUTURES	3	3	1-3
SUTURES TIED	Yes	No	No

Aortic valve repair

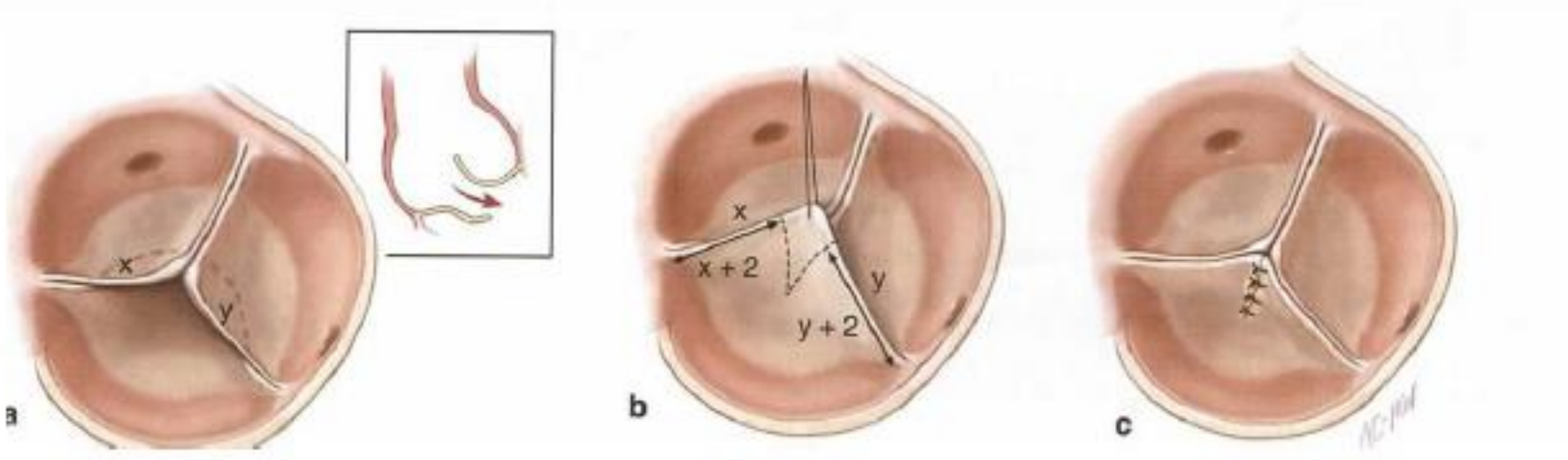
Annular dilatation



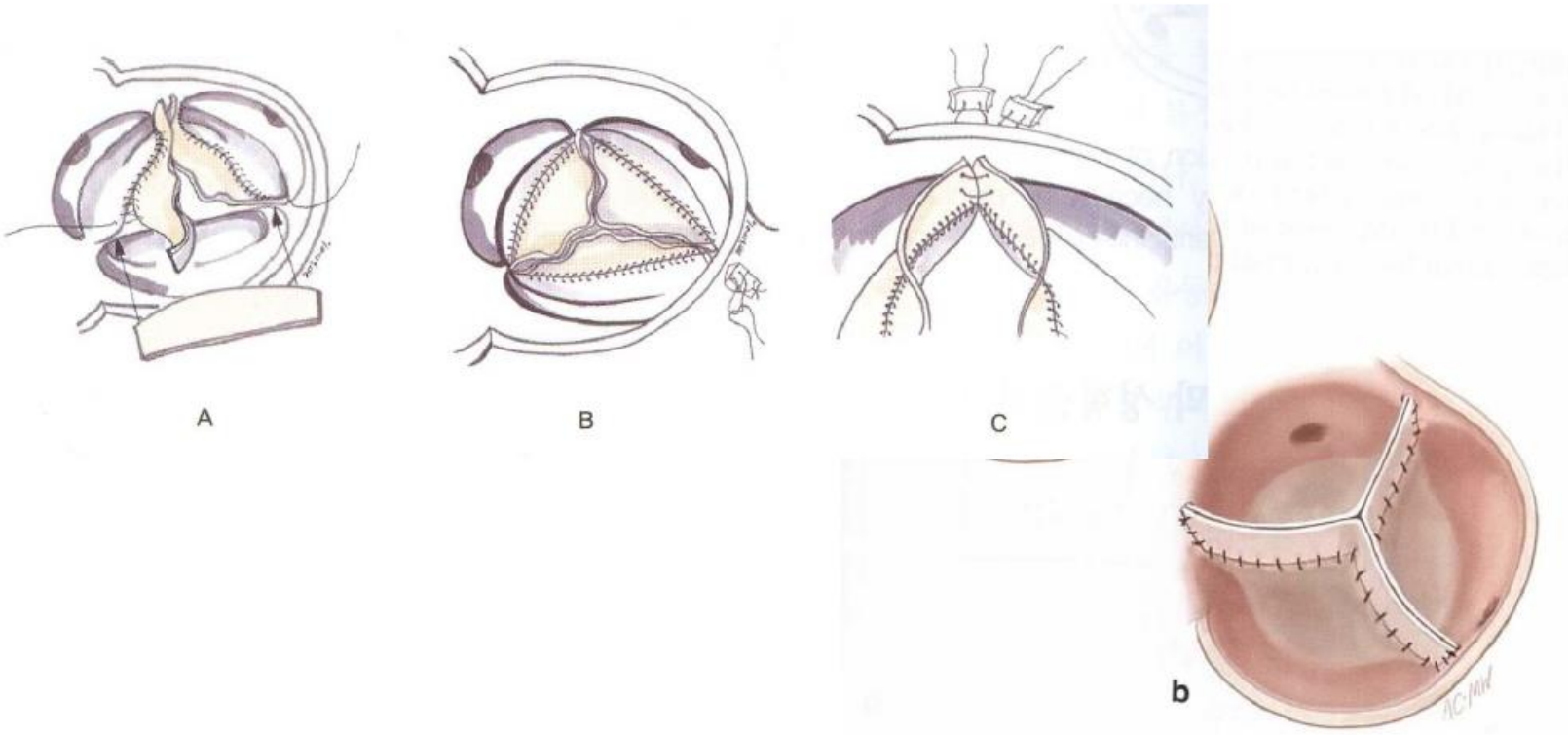
Leaflet perforation



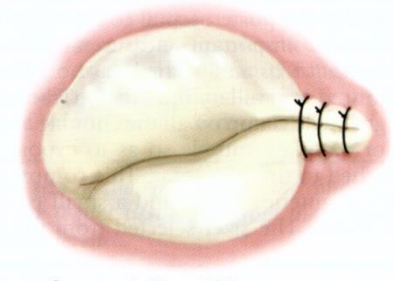
Leaflet Prolapse



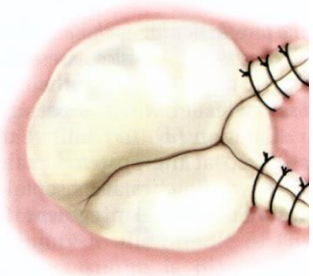
Leaflet extension



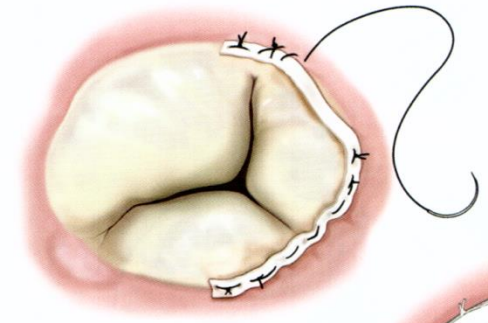
Tricuspid valve repair



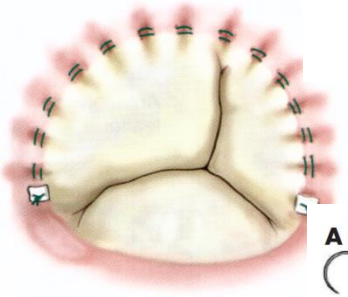
a J. Kay 1965



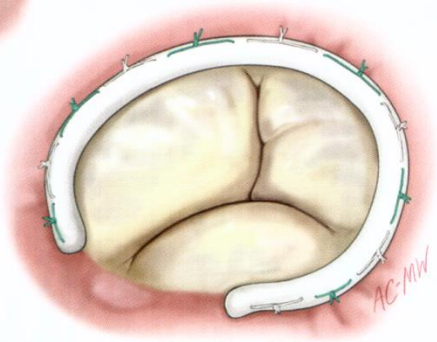
b Modified Kay



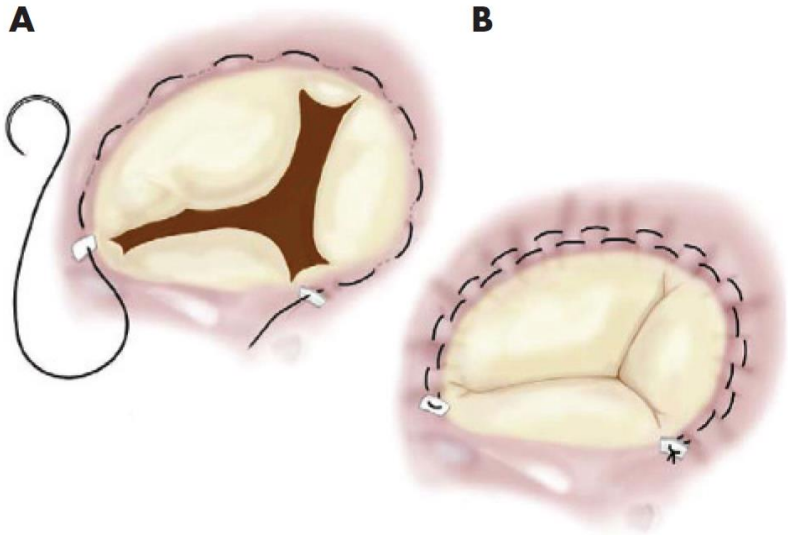
c Dubost 1967

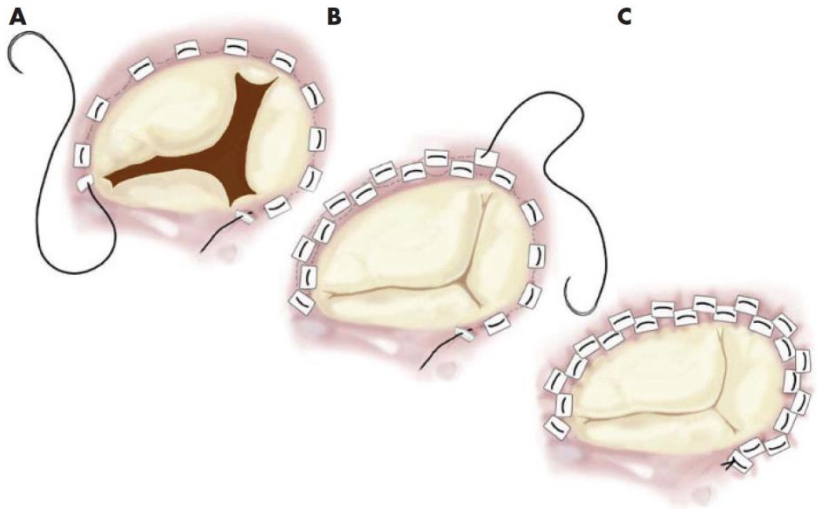


d DeVega 1972

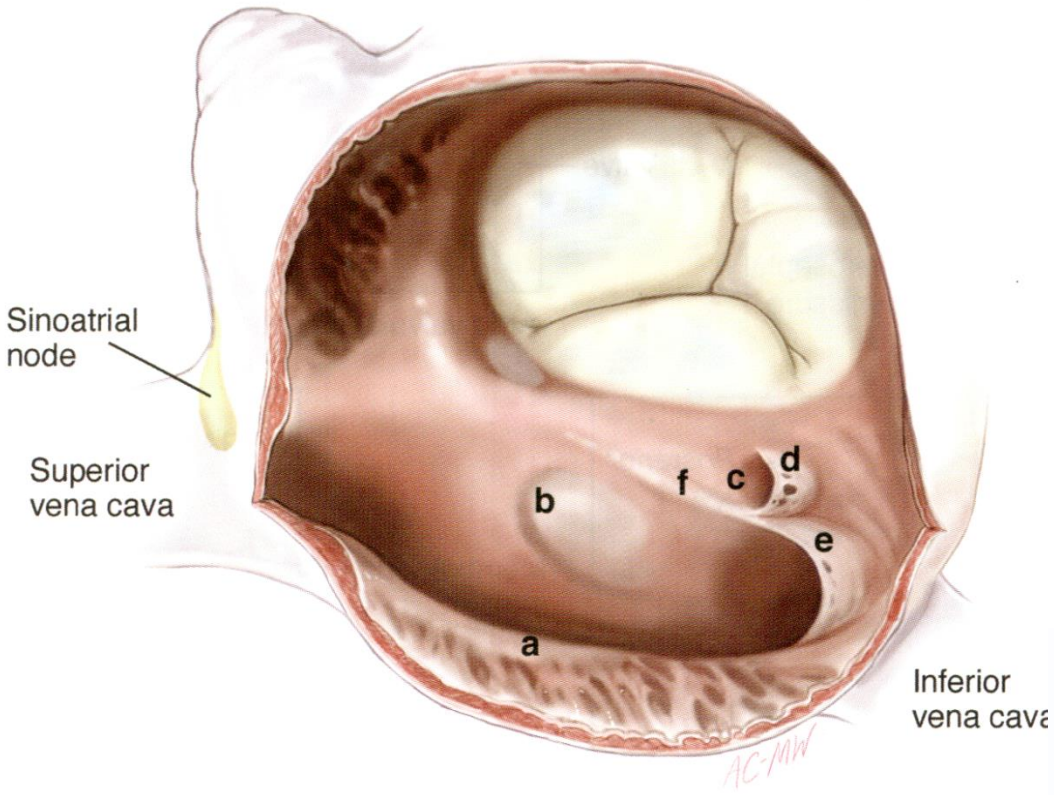


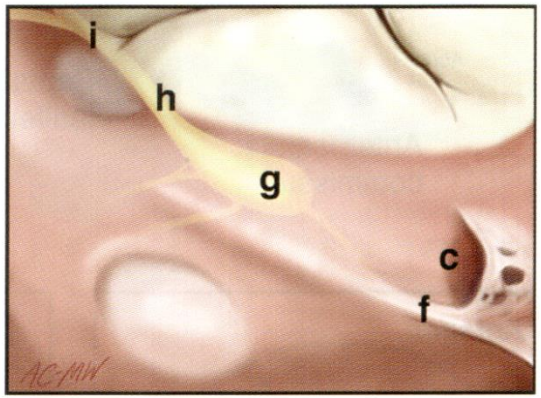
e Carpentier 1971

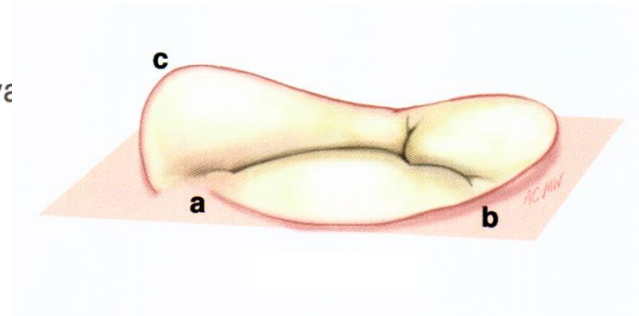




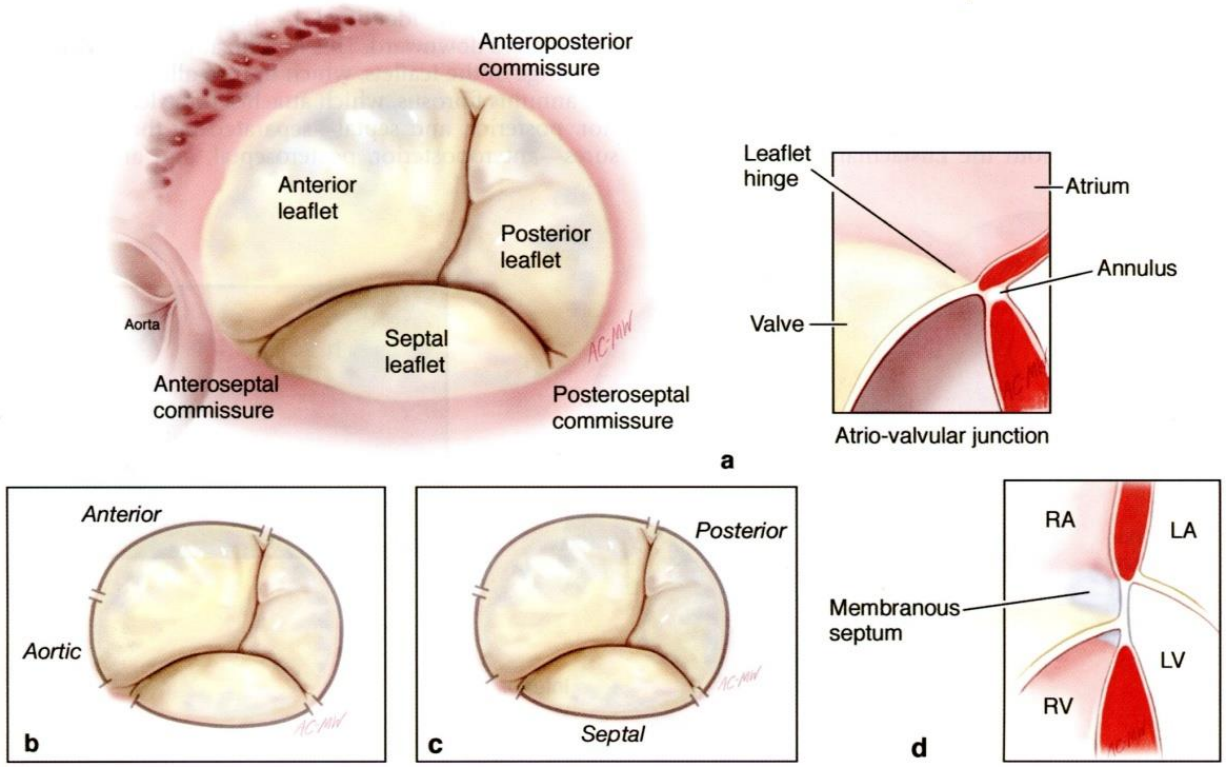
Anatomy of Tricuspid valve

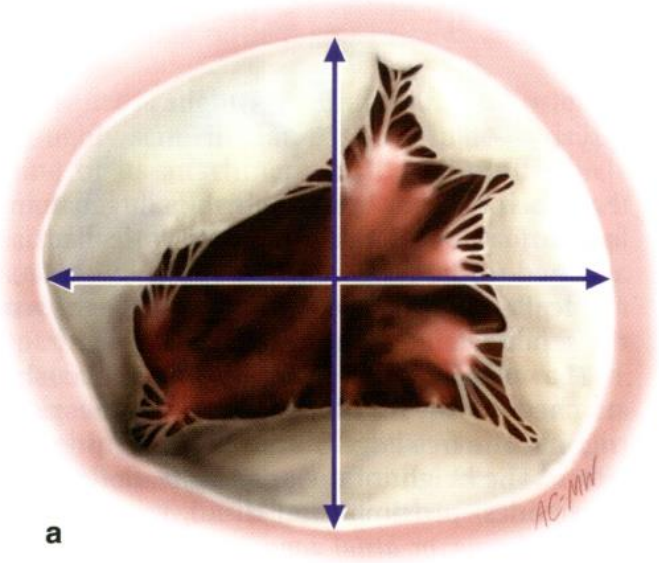

Sinoatrial node
Superior vena cava
Inferior vena cava
a
b
c
d
e
f
AC-MW


i
h
g
c
f
AC-MW

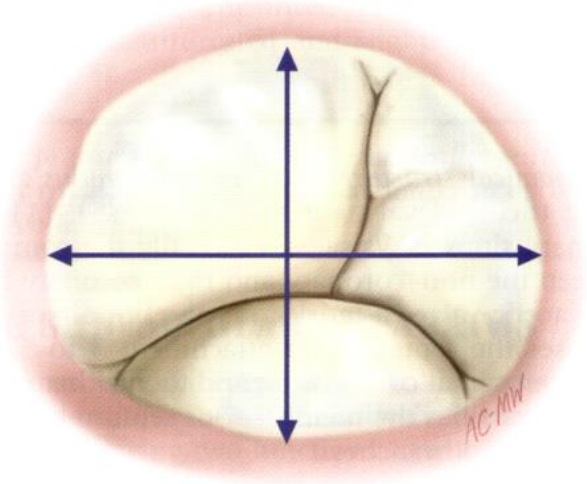

c
a
b
AC-MW

Annulus

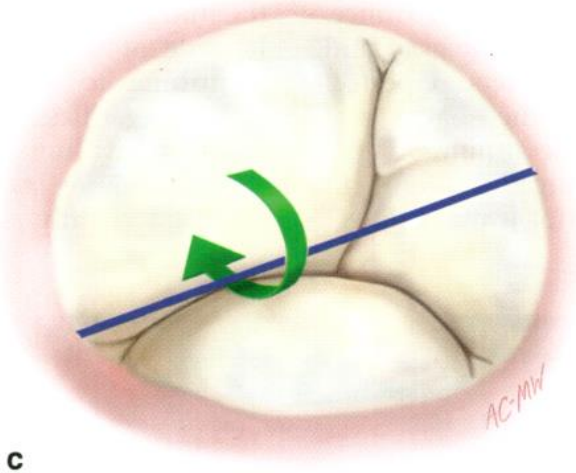

Anteroposterior commissure
Anterior leaflet
Posterior leaflet
Aorta
Septal leaflet
Anteroseptal commissure
Posteroseptal commissure
a
Leaflet hinge
Atrium
Annulus
Valve
Atrio-valvular junction
Anterior
Aortic
b
Posterior
Septal
c
RA
LA
Membranous septum
LV
RV
d



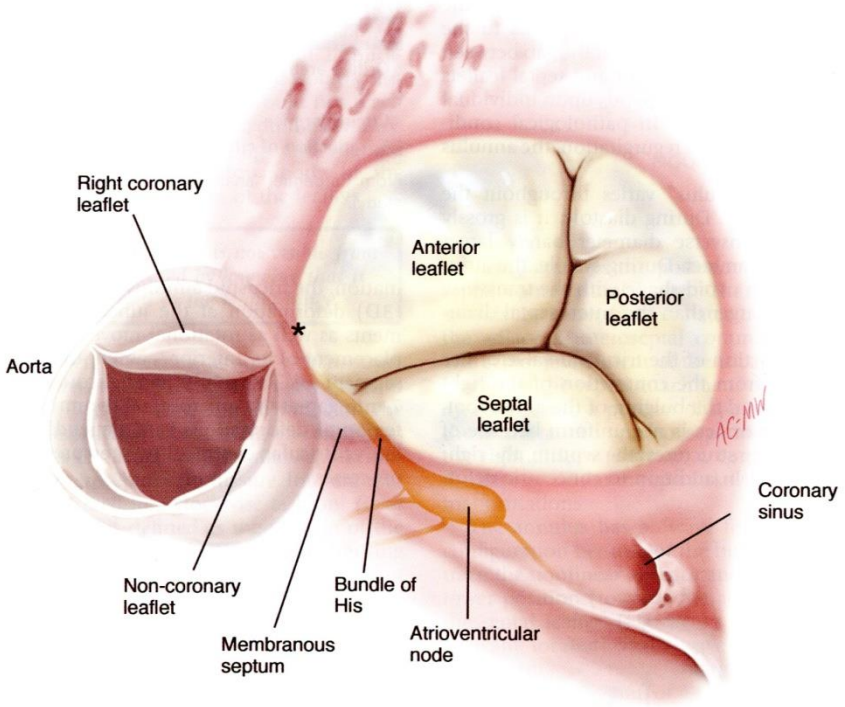
a

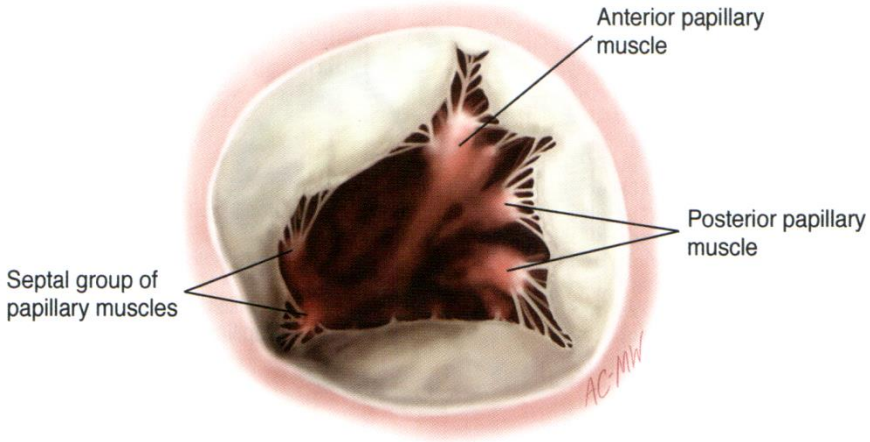


b

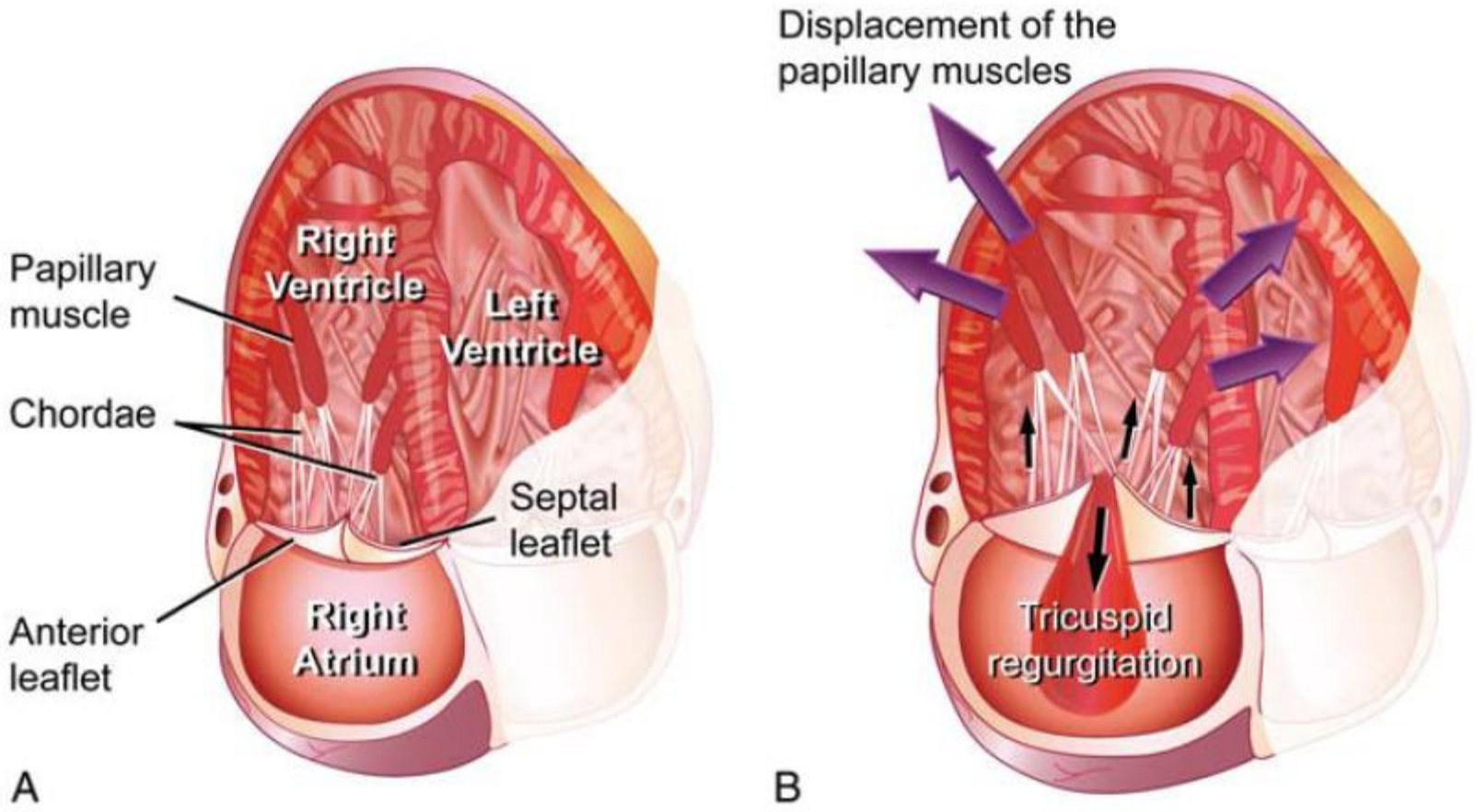


c


Right coronary leaflet
Anterior leaflet
Posterior leaflet
Aorta
*
Septal leaflet
Coronary sinus
Non-coronary leaflet
Bundle of His
Membranous septum
Atrioventricular node


Anterior papillary muscle
Posterior papillary muscle
Septal group of papillary muscles

Functional TR



Mascherbauer J, EHJ;2010;31:2841–2843

Ring annuloplasty

- **<u>Differential Annulus Dilatation</u>**

  : Dilatation of the annulus does not affect all leaflets the same

  – Posterior leaflet can increase up to 80%

  – Anterior leaflet can increase up to 40%

  – Septal leaflet can increase up to 10%

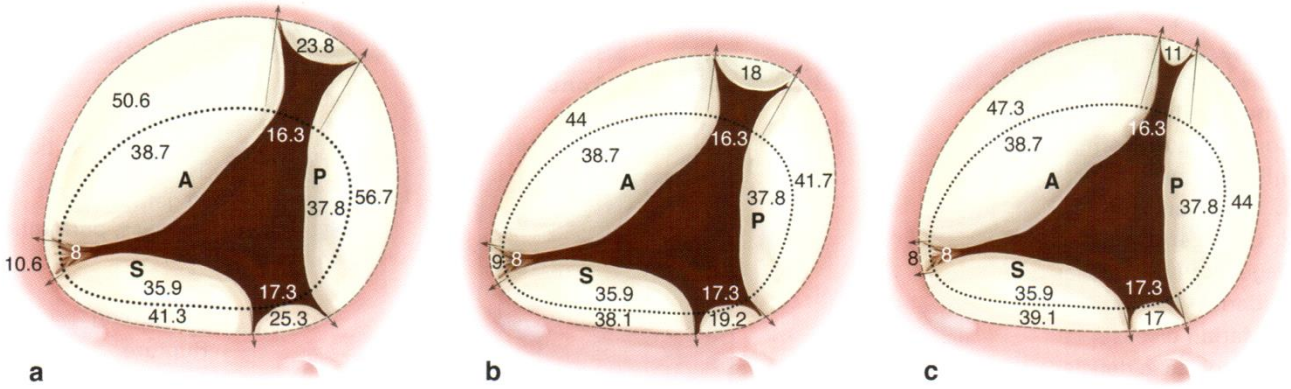
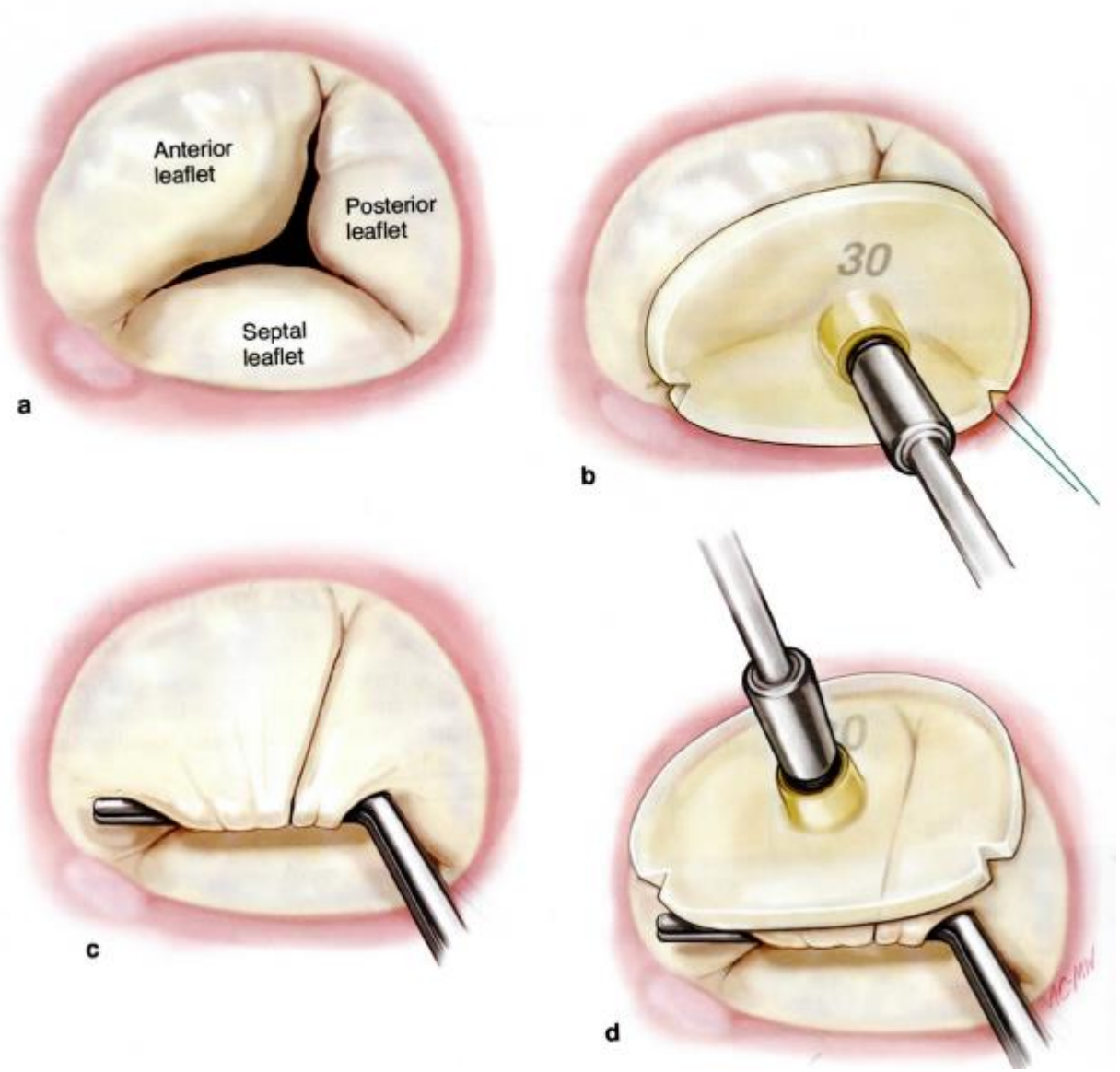


Table 1. Commonly Used Rings and Bands for the Treatment of Functional Tricuspid Regurgitation

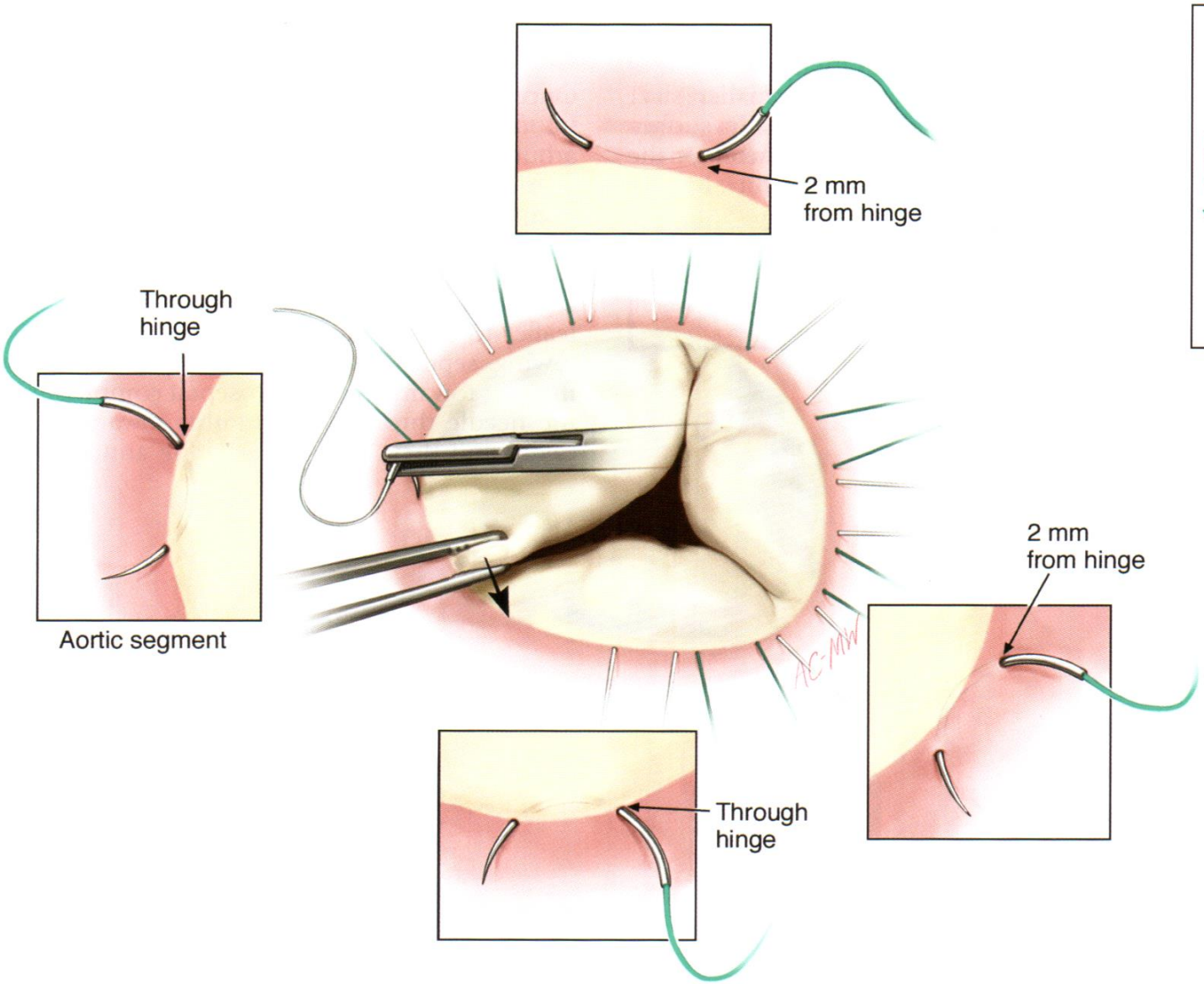
Name	Manufacturer	Rigid or Flexible	Size and Shape (Closed or Open)	Comments
Carpentier-Edwards	Edwards Lifesciences	Rigid Ring	26-36 mm open	Dedicated tricuspid, planar
Cosgrove-Edwards	Edwards Lifesciences	Flexible band	26-38 mm open	Mitral or tricuspid
MC3	Edwards Lifesciences	Rigid titanium Ring	26-36 mm open 3D	Dedicated tricuspid, 3D conformation
Duran AnCore	Medtronic	Flexible ring or band	25-35 mm closed or open	Mitral or tricuspid
Tailor	St. Jude Medical	Flexible ring or band	Closed or open	Mitral or tricuspid
Annuloflex	CarboMedics	Flexible ring or band	26-36 mm convertible closed or open	Mitral or tricuspid
Simulus	ATS Medical	Flexible ring or band	23-35 mm closed or open	Mitral or tricuspid

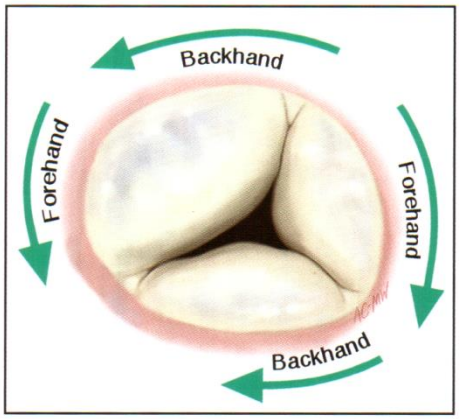
Rogers JH, Bolling SF, et al. Semin Thoracic Surg 22:84-89

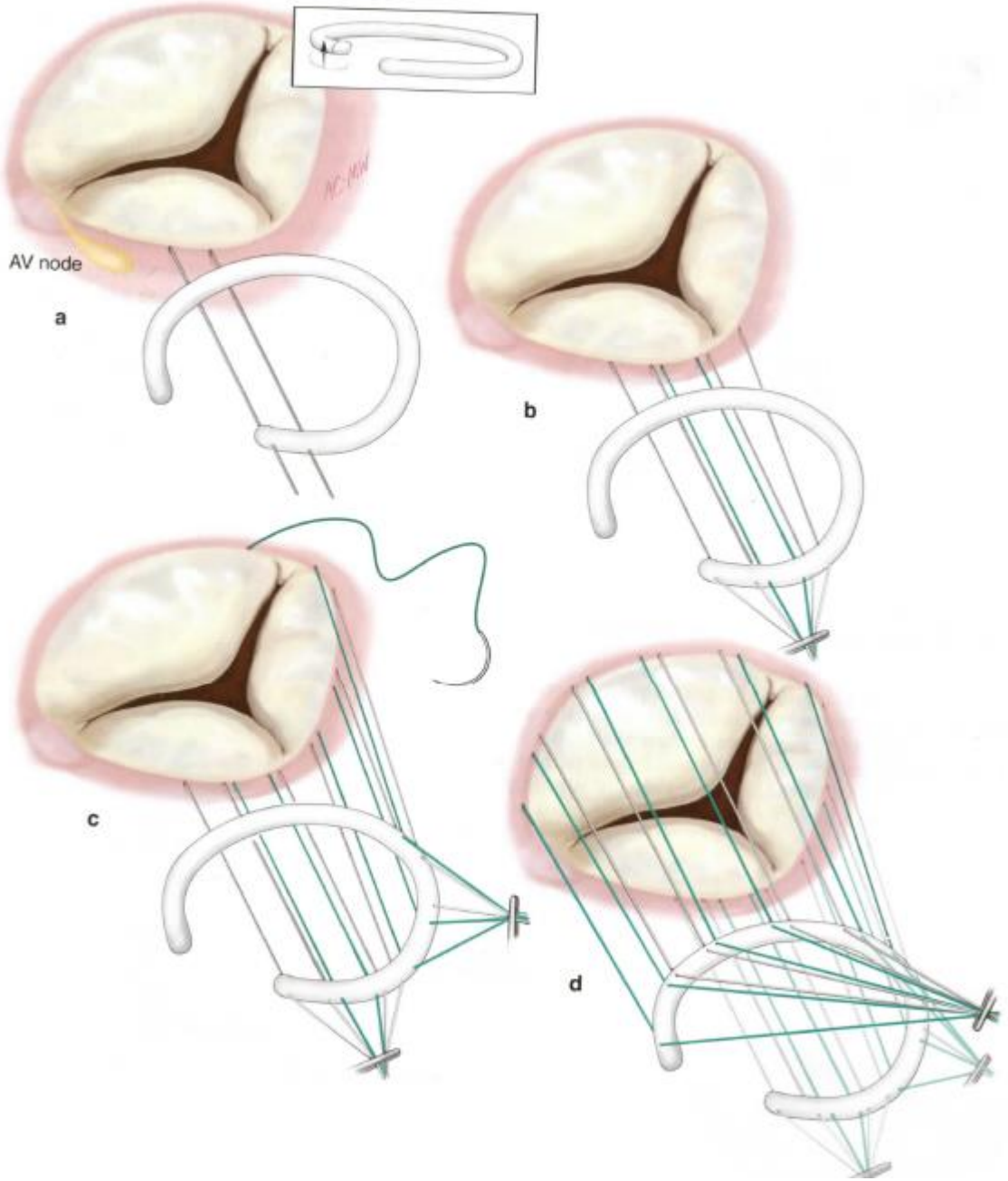
Ring sizing


Anterior leaflet
Posterior leaflet
Septal leaflet
a
30
b
c
d

Ring suture


2 mm
from hinge
Through
hinge
Aortic segment
2 mm
from hinge
Through
hinge


Backhand
Forehand
Forehand
Backhand


AV node
a
b
c
d


a

Summary

- **Adequate knowledge for Valve**
- **Adequate exposure of valve**
- **Safe, secure suture**