

# Aortic Valve Replacement

**Jae Woong Choi, MD, PhD**

**Assistant Professor**

**Seoul National University Hospital**

**Seoul National College of Medicine**

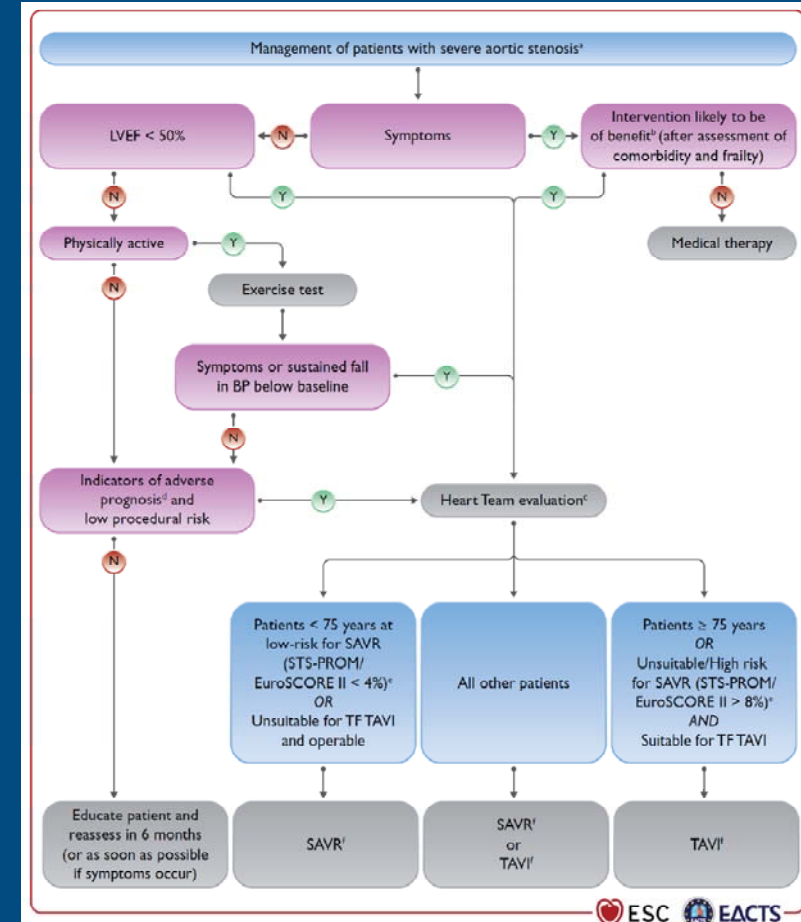
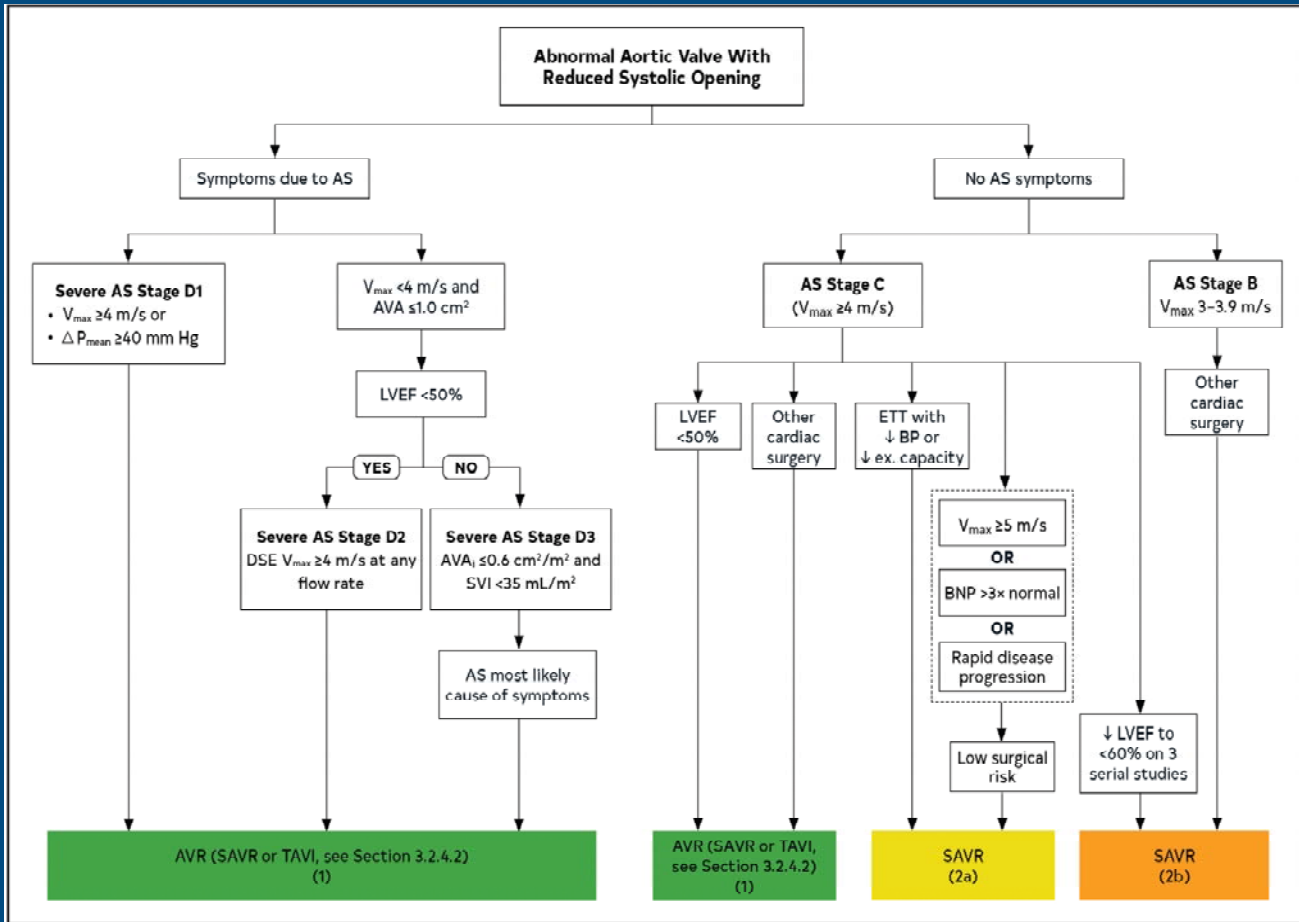
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  - Current guidelines : 2020 AHA/ACC and 2021 ESC/EACTS guidelines
- ✓ Surgical Anatomy of Aortic Valve
- ✓ How to Perform the Conventional Aortic Valve Replacement
- ✓ Considering Factors for surgical AVR
  - : MICS, Anatomy

# Indications of Aortic Valve Replacement

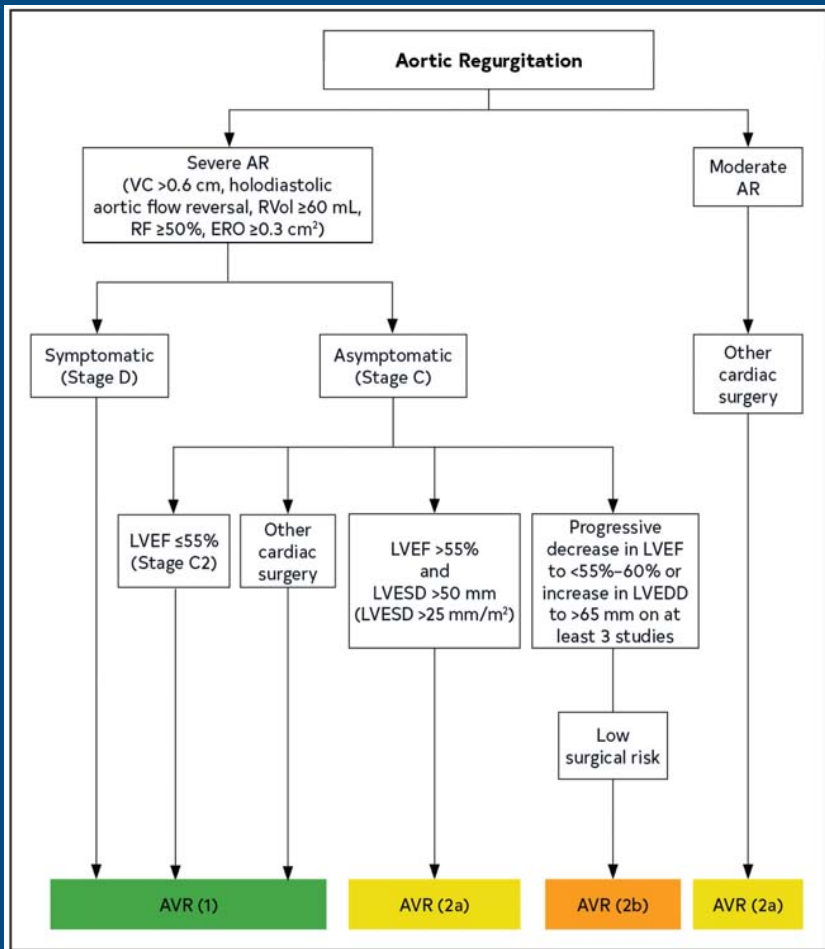
✓ 2020 AHA/ACC guideline

✓ 2021 ESC/EACTS guideline

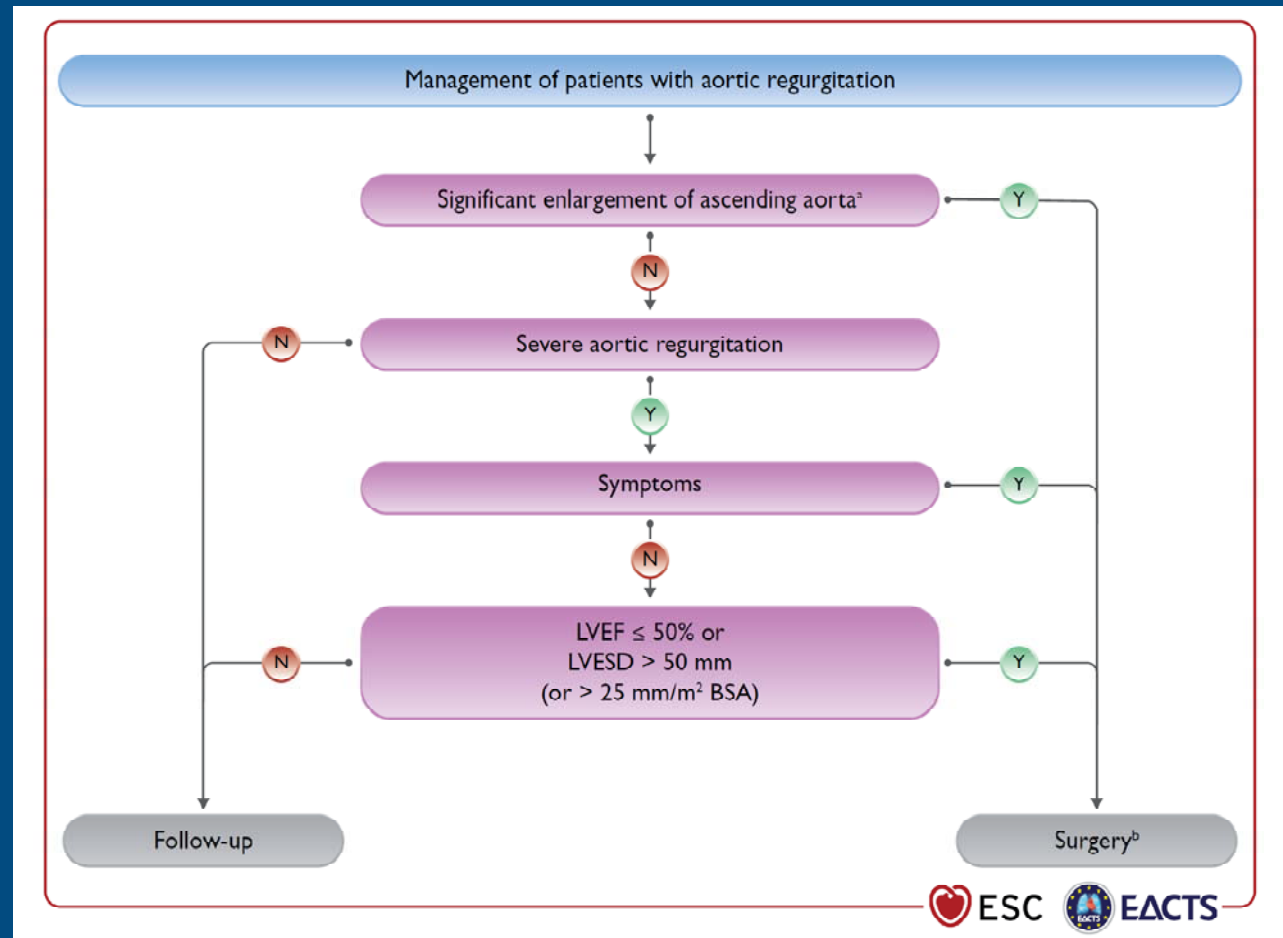


# Indications of Aortic Valve Replacement

✓ 2020 AHA/ACC guideline



✓ 2021 ESC/EACTS guideline

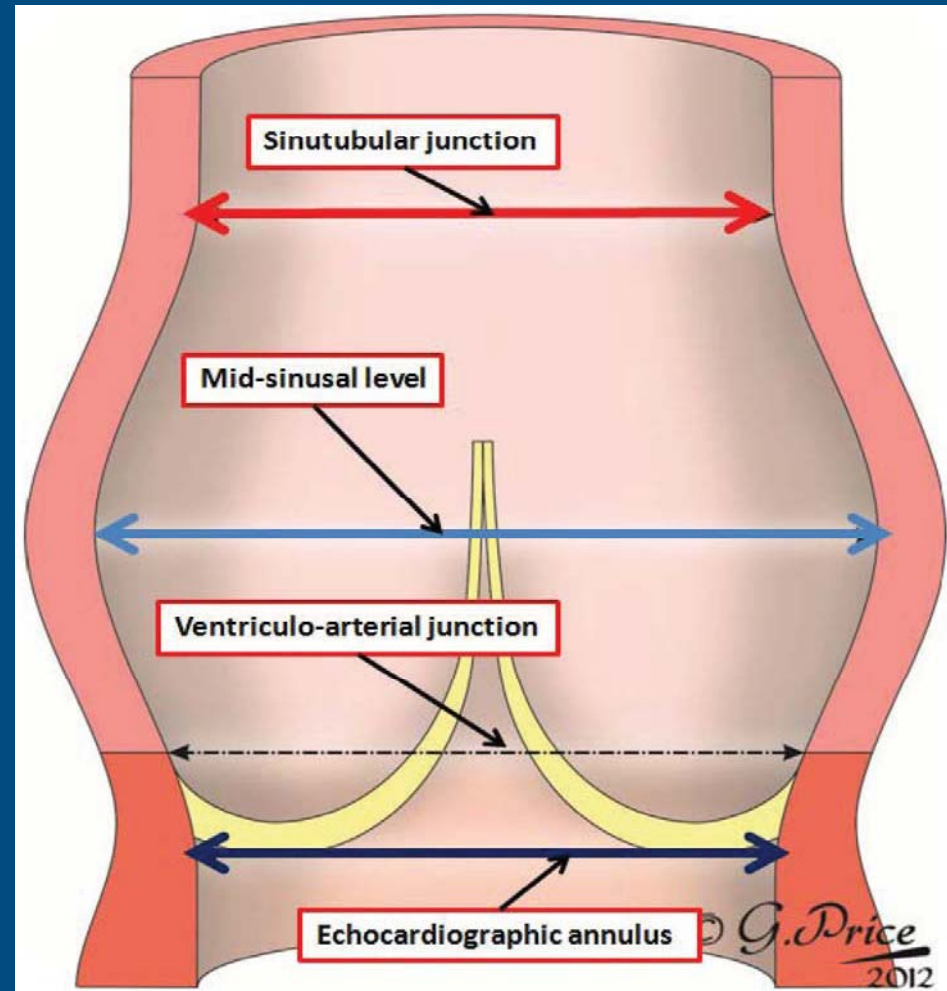


# Indications of Aortic Valve Replacement

- ✓ Severe AS w/ symptom
- ✓ Severe AR w/ symptom
- ✓ Severe AS w/o symptom
  - LVEF < 50%
  - Exercise treadmill test (+),  $V_{max} \geq 5\text{m/s}$ , BNP > 3 x normal, rapid progression
- ✓ Severe AR w/o symptom
  - LVEF  $\leq 55\%$
  - LVESD >50mm or >25mm/m<sup>2</sup>

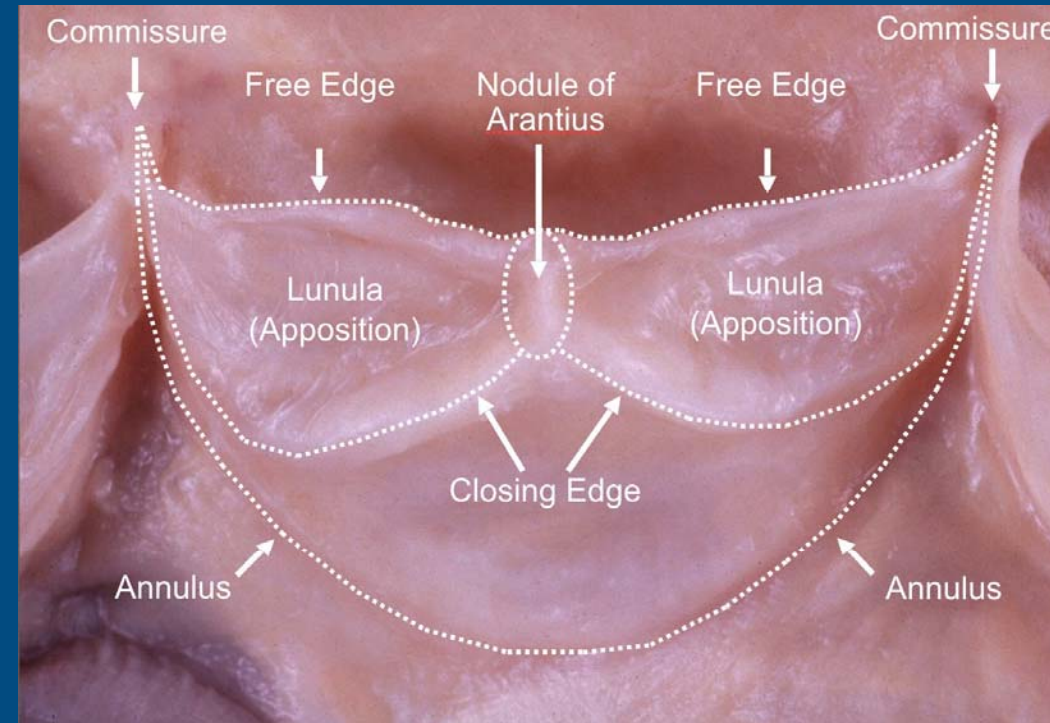
# Surgical Anatomy of Aortic Valve

- ✓ Aortic valve leaflets
- ✓ Sinotubular junction
- ✓ Interleaflet triangle
- ✓ Sinuses of Valsalva
- ✓ Coronary arteries
- ✓ Annulus



# Aortic valve leaflets

- ✓ Three leaflets
- ✓ Three parts
  - : Free edge (thicker than basal portion)
  - : Belly
  - : Leaflet attachments (semilunar fashion)
- ✓ Lunula – apposition zone of leaflets
- ✓ Nodule of Arantius
  - : Mid-portion of the lunula



Part 4

# Aortic valve leaflets – normal heart

✓ Area of the leaflets –NCC > LCC > RCC

10 donor heart unsuitable TPL

**Table III.** Human aortic leaflet dimensions

|                           | <i>Right</i> | <i>Left</i>  | <i>Noncoronary</i> | <i>Average</i> |
|---------------------------|--------------|--------------|--------------------|----------------|
| Height (cm)               | 1.33 ± 0.06  | 1.39 ± 0.08  | 1.37 ± 0.04        | 1.36 ± 0.06    |
| Free margin length (cm)   | 3.30 ± 0.14  | 3.15 ± 0.14* | 3.27 ± 0.13        | 3.24 ± 0.13    |
| Attached edge length (cm) | 4.64 ± 0.20  | 4.76 ± 0.22  | 4.81 ± 0.16        | 4.74 ± 0.19    |
| Perimeter (cm)            | 7.94 ± 0.33  | 7.91 ± 0.35  | 8.08 ± 0.28        | 7.98 ± 0.31    |
| Area (cm <sup>2</sup> )   | 2.97 ± 0.17  | 3.09 ± 0.27  | 3.17 ± 0.18        | 3.07 ± 0.21    |

Values given as mean plus or minus standard error of the mean.

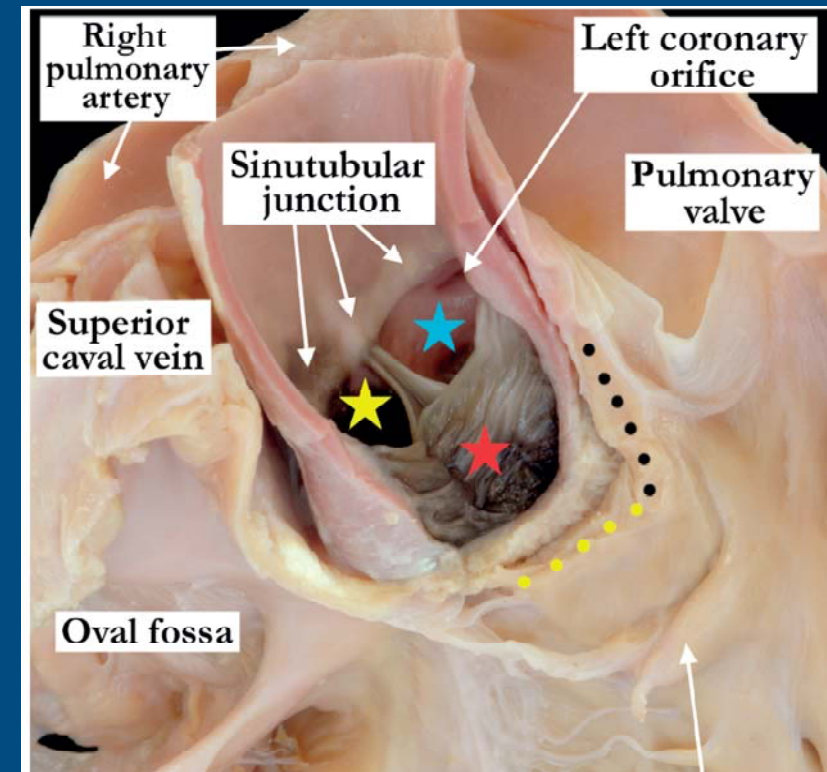
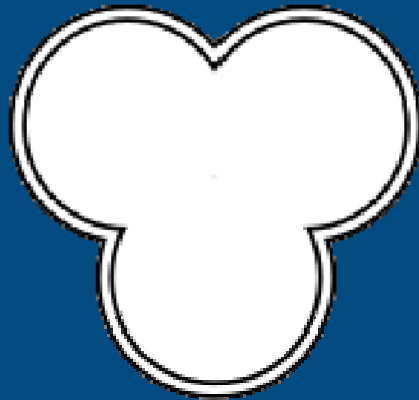
\**p* < 0.05, left < right, left < noncoronary, one-way ANOVA.

Kunzelman et al. JTCS 1994;107:162-70



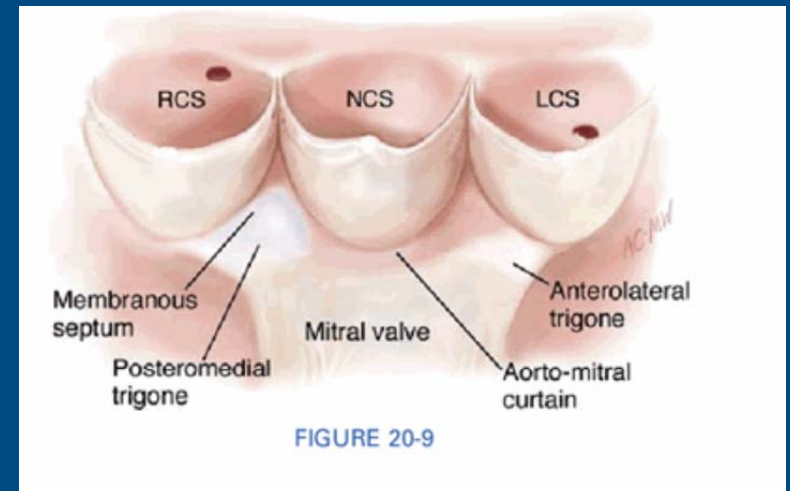
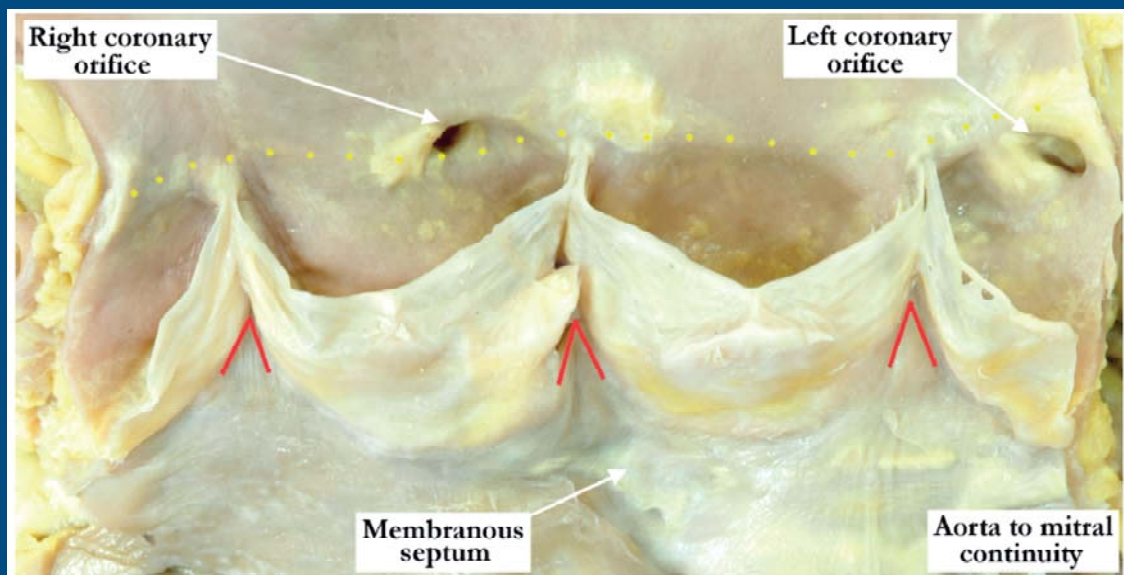
# Sino-tubular junction

- ✓ Separate the aortic root from the ascending aorta
- ✓ Slightly raised ridge of thickened aortic wall on the aortic lumen (smooth outside)
- ✓ 75% of the maximal sinus diameter
- ✓ Not perfectly circular (mildly trefoil or scalloped)

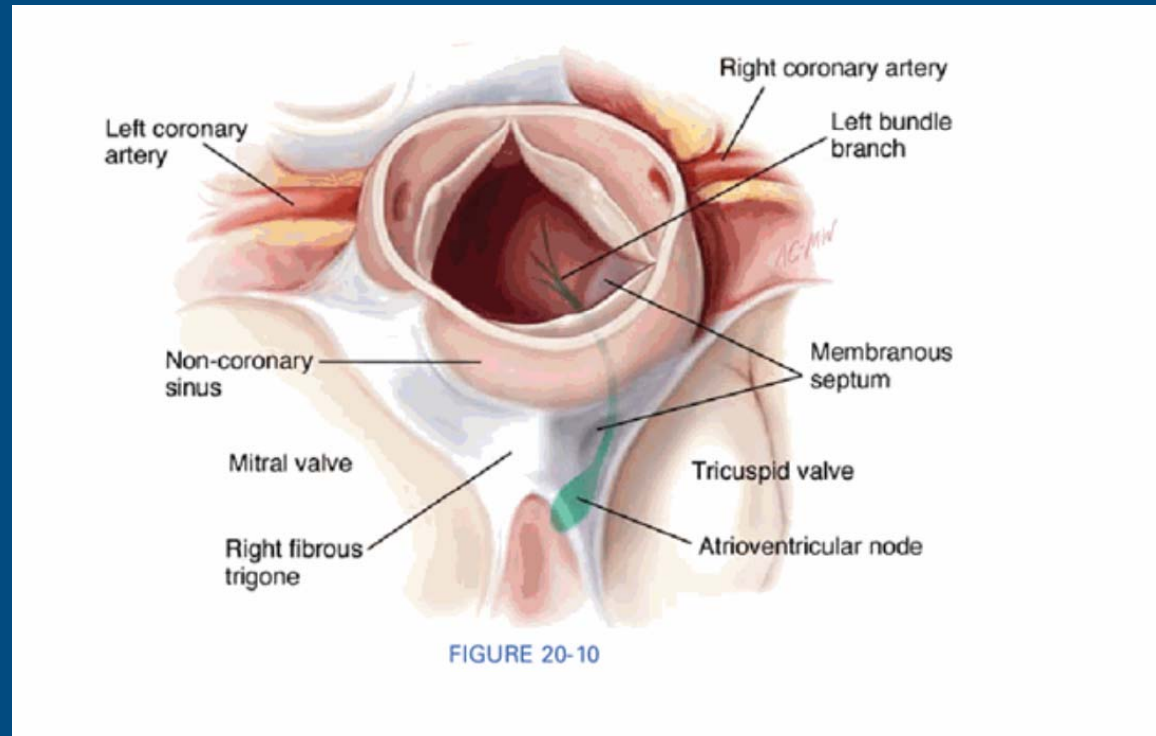
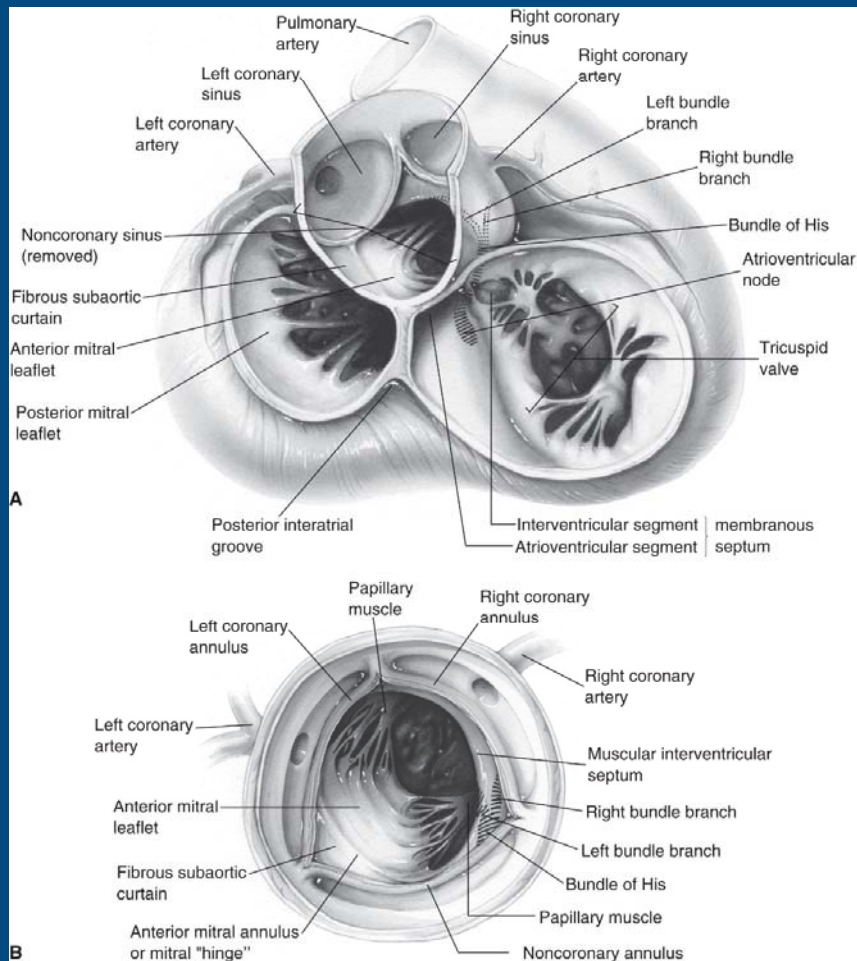


# Interleaflet triangles

- ✓ Spaces beneath the apices formed by commissures
- ✓ Subcommissural triangles
- ✓ Beneath the NCC – fibrous portion
- ✓ Beneath the between RCC and LCC : muscular portion + fibrous portion



# Interleaflet triangles



# Coronary arteries

- ✓ Below the STJ (STJ : 9%, above STJ: 22%)
- ✓ Height : LCA –  $12.6 \pm 2.61$ mm, RCA –  $13.2 \pm 2.64$ mm

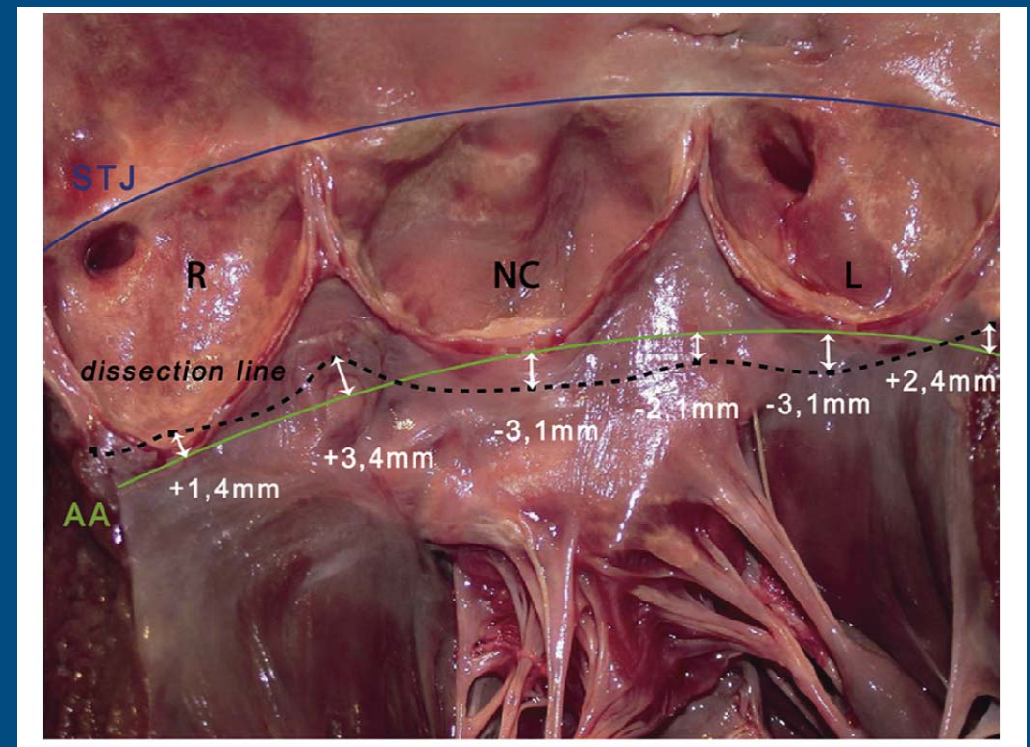
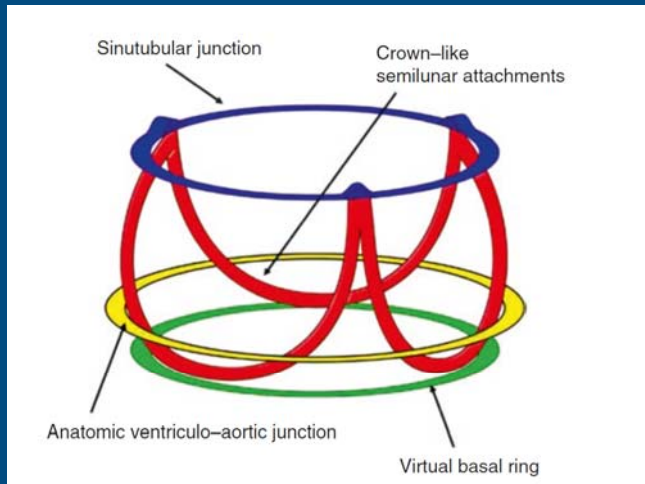
# Annulus

✓ 2 circular rings and 1 crown-like ring

(1) Surgical aortic annulus – crown-like ring (attachments of the aortic cusps)

(2) Virtual basal ring

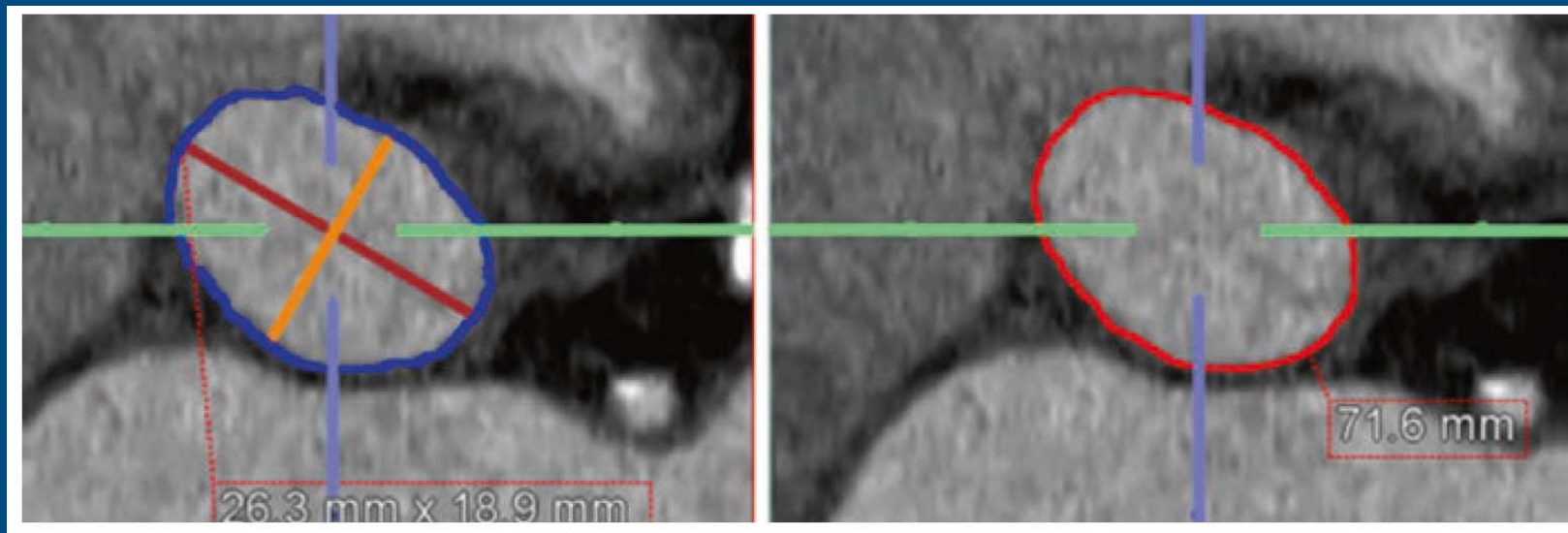
(3) Ventriculo-aortic junction (VAJ)



# Annulus – virtual basal ring

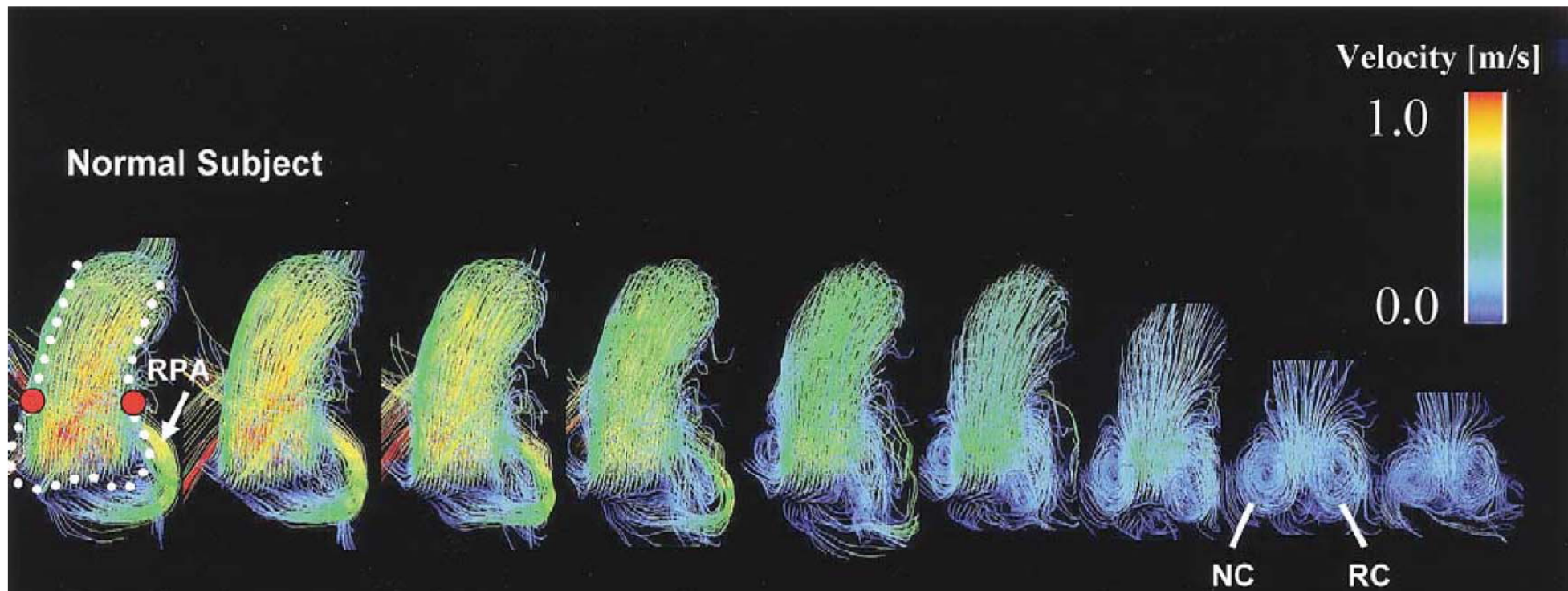
- ✓ Virtual line connecting the nadir of each of the cusps
- ✓ Echocardiographic “annulus”
- ✓ Elliptical shape in CT scan

minor to major diameter ratio = 0.66



# Sinuses of Valsalva

- ✓ Important role to create the vortex

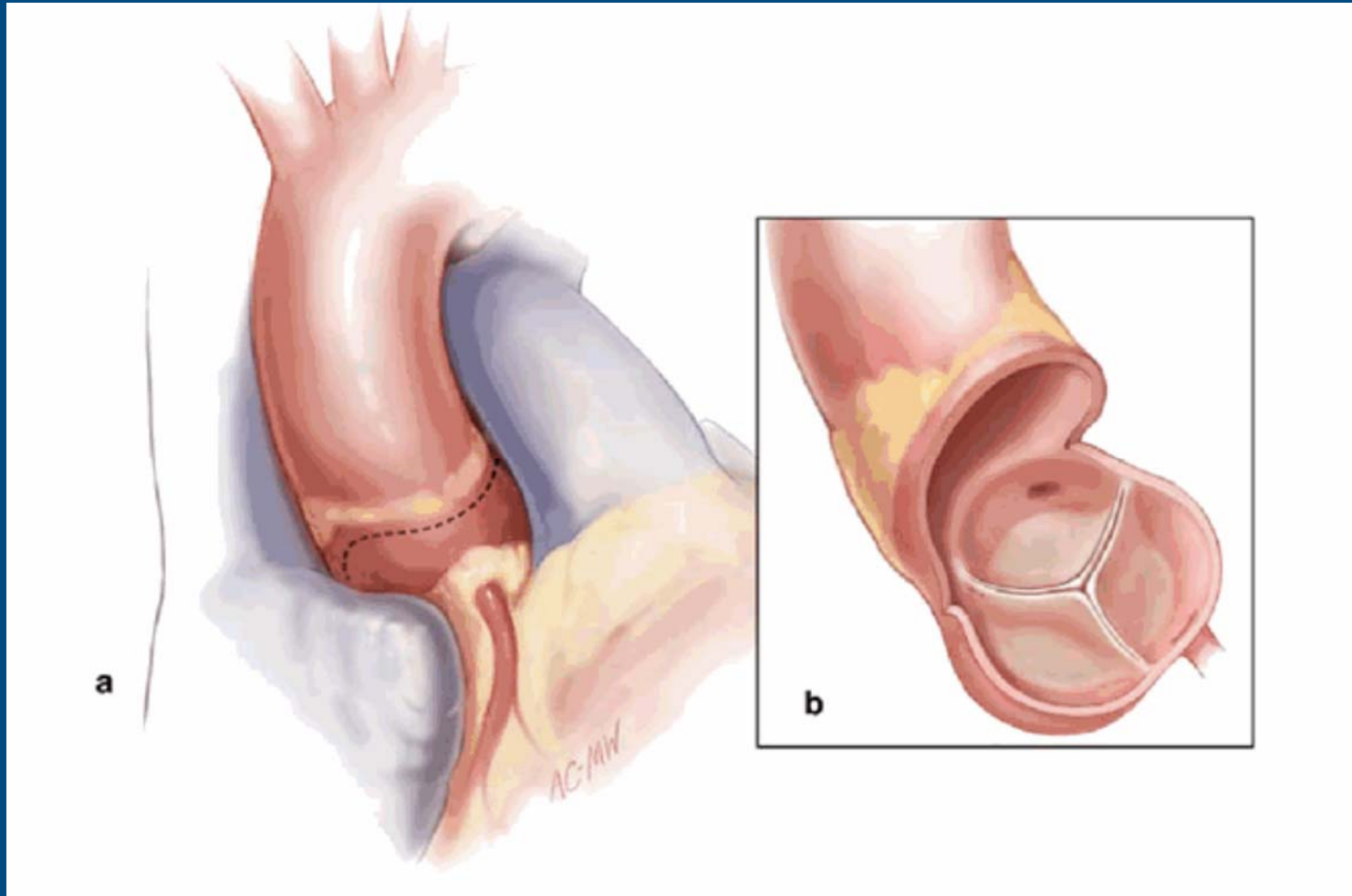


# Sinuses of Valsalva

- ✓ Vortex in sinus of Valsalva
- Blood flows back from the STJ along the walls of the SOV
- Stress reduction of aortic leaflets
- : Prevent apposition of the leaflets against the aortic wall
- : Atraumatic closure during late systole and diastole
- Support coronary flow



# How to Perform the Conventional Aortic Valve Replacement



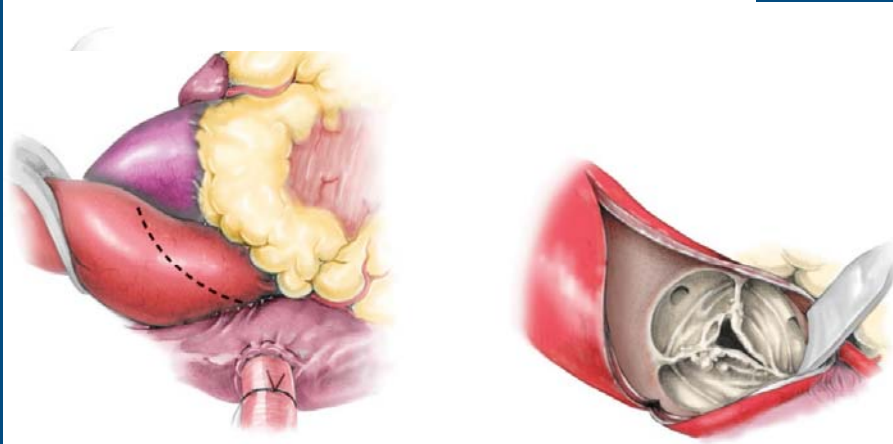
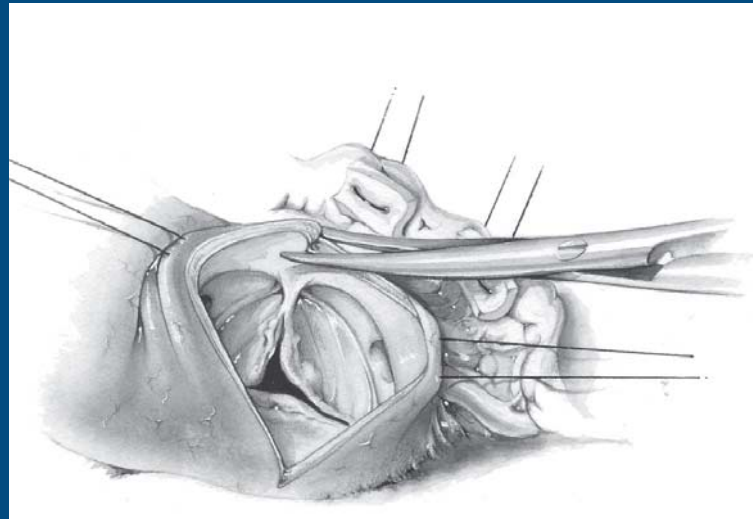
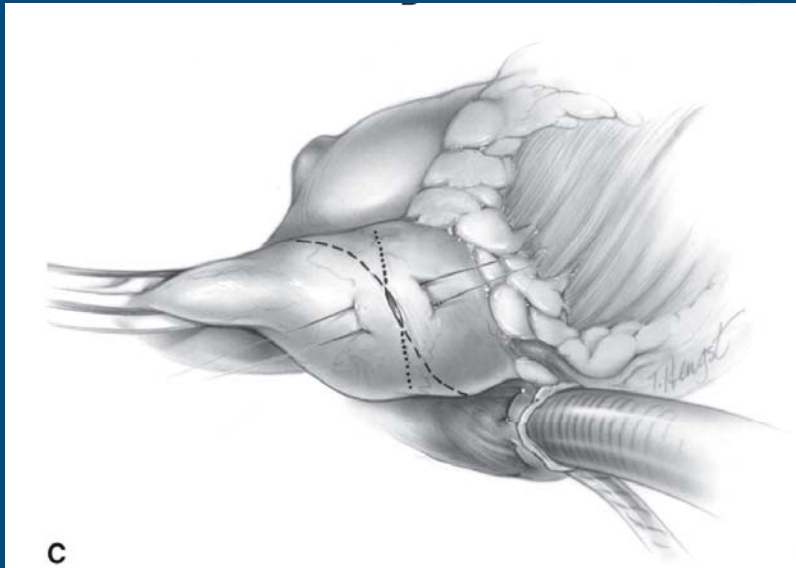
# How to Perform the Conventional Aortic Valve Replacement

## Operative procedure

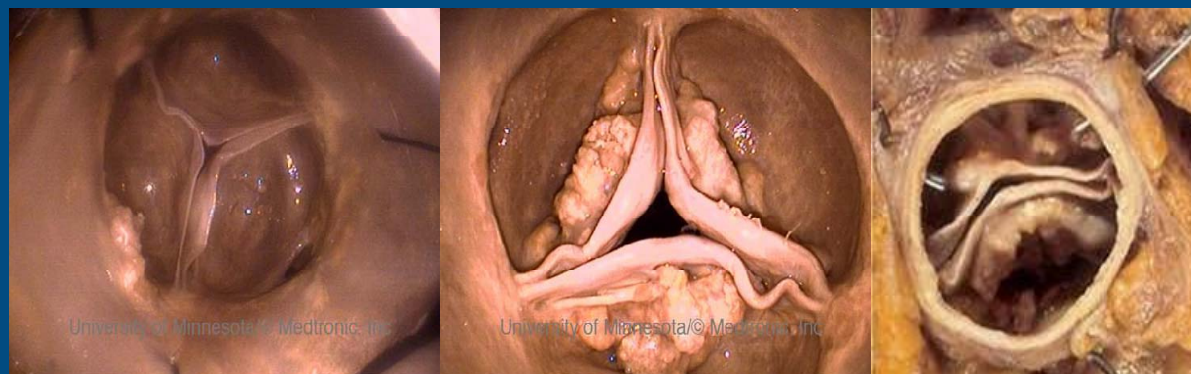
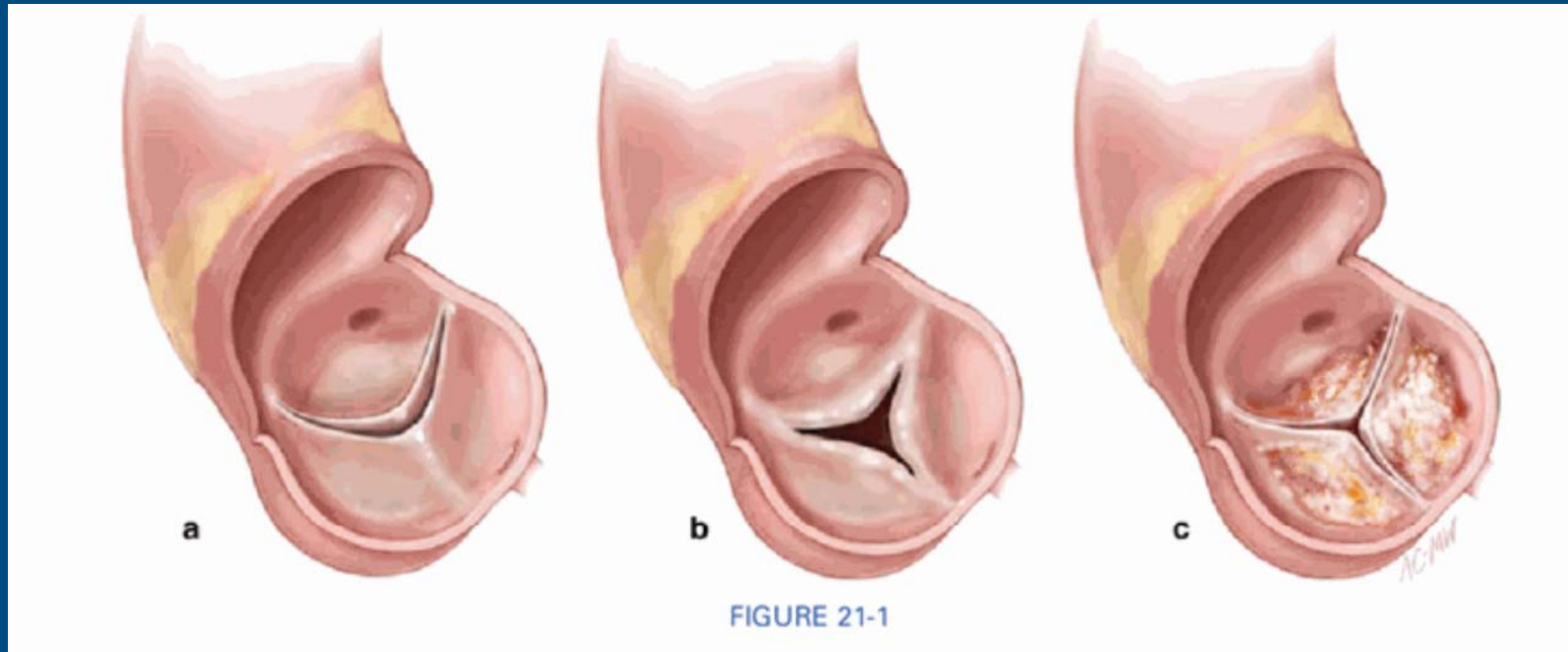
- Median sternotomy
- Pump start : A line (ascending aorta), V line (SVC, IVC), cardioplegia (antegrade, retrograde, direct)
- Aortotomy
- Leaflet excision and decalcification
- Annular suture
- Valve sewing ring suture
- Tying down
- Aortotomy closure (double layers : horizontal mattress suture + over- and over suture)

# How to Perform the Conventional Aortic Valve Replacement

Aortotomy: transverse or oblique (hockey-stick)

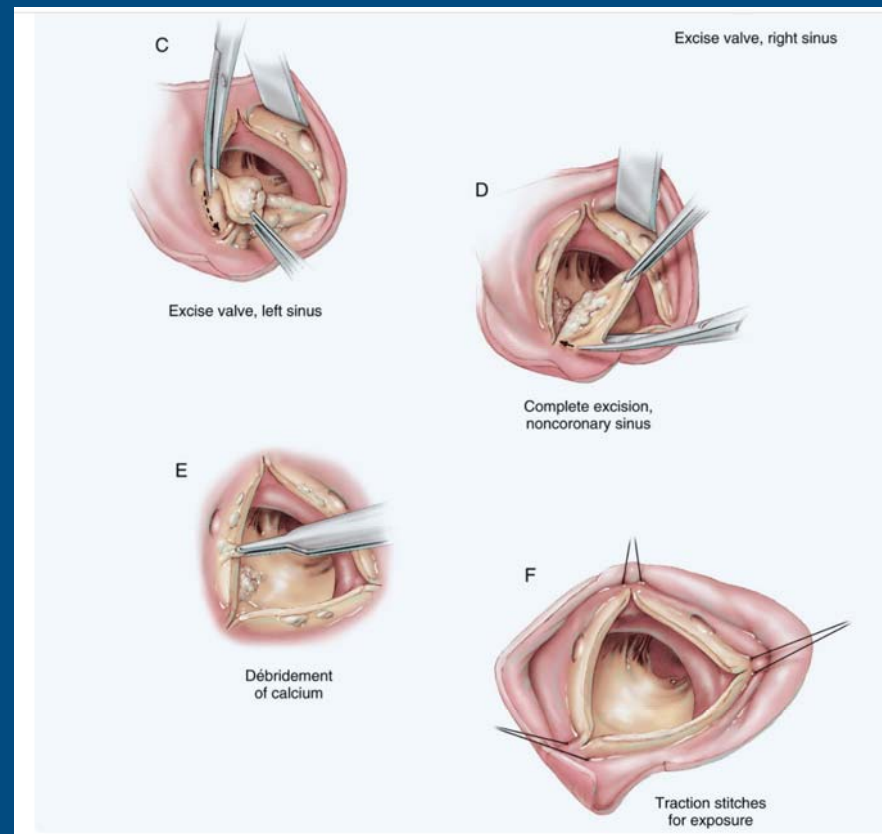
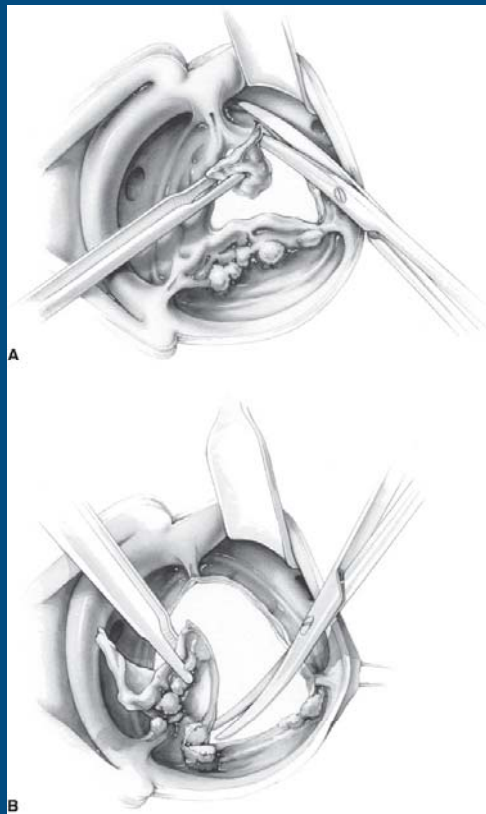


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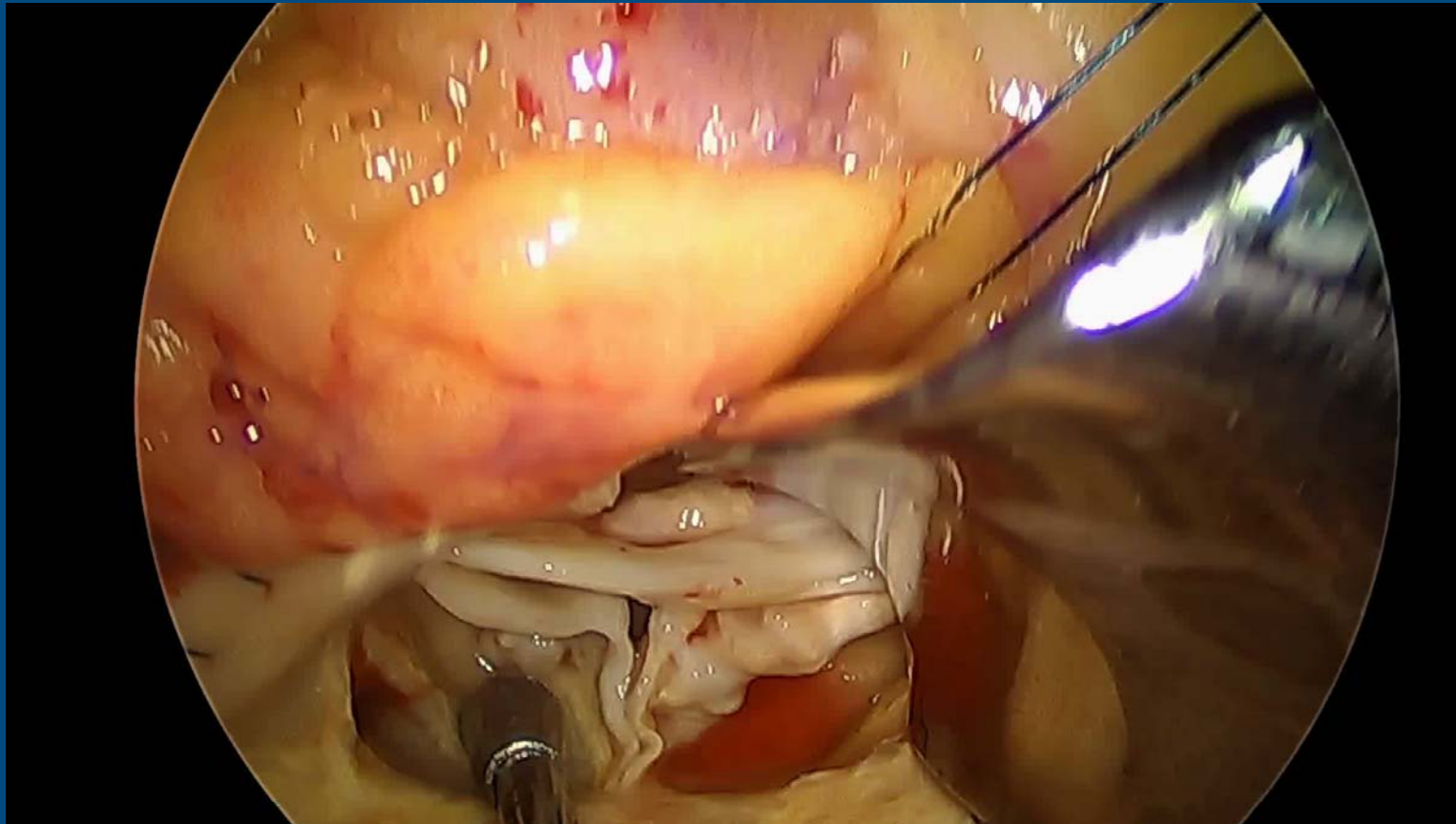


# How to Perform the Conventional Aortic Valve Replacement

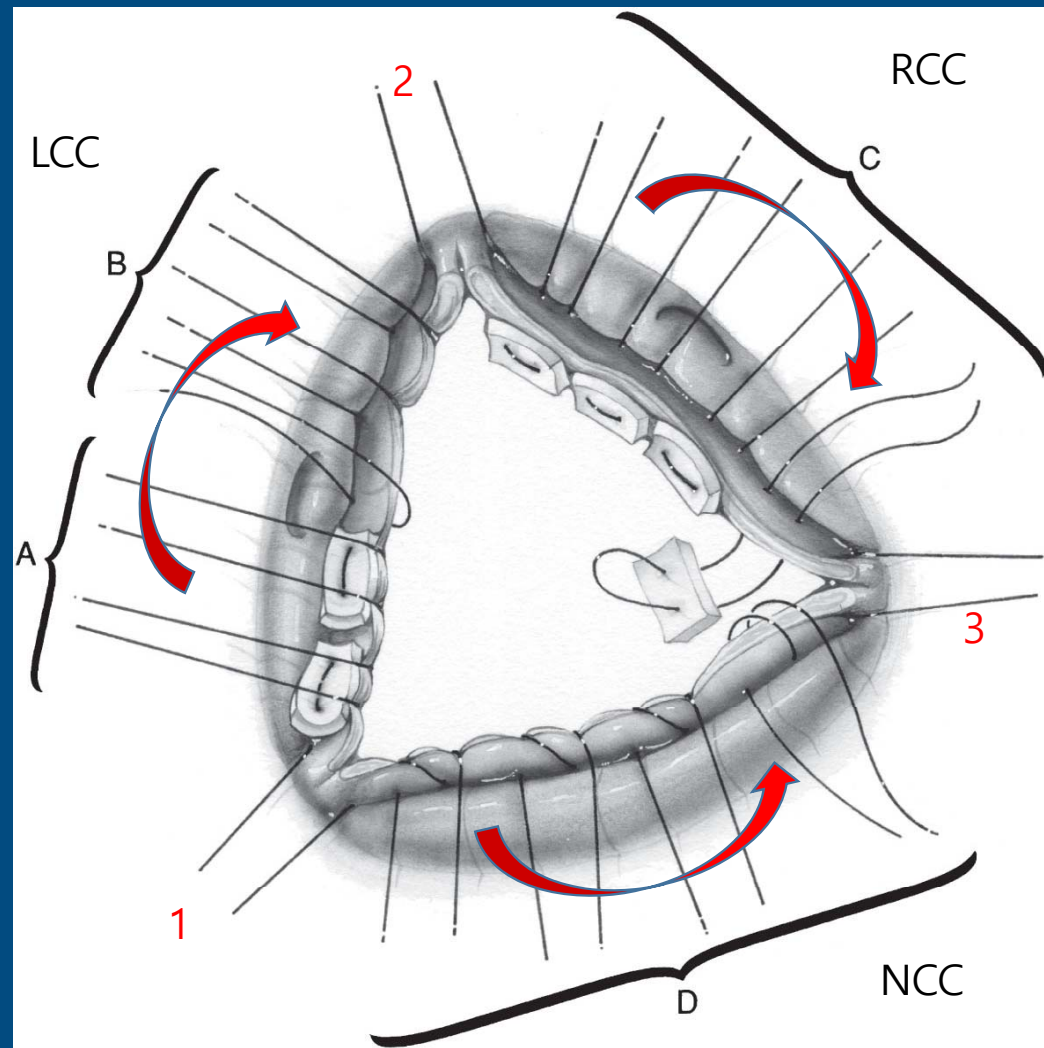
## Leaflet excision and decalcification



# How to Perform the Conventional Aortic Valve Replacement



# How to Perform the Conventional Aortic Valve Replacement



## 1. Interrupted suture technique

A: everting sutures

B: Simple sutures.

C: Non-everting sutures

D: Figure-of-eight suture

## 2. Continuous suture technique

자기 자신의 routine technique이 필요함 !!!

Orders of sutures (by JW Choi)

1. Commissure - NCC and LCC, LCC and RCC, RCC and NCC
2. LCC, RCC and NCC

# How to Perform the Conventional Aortic Valve Replacement

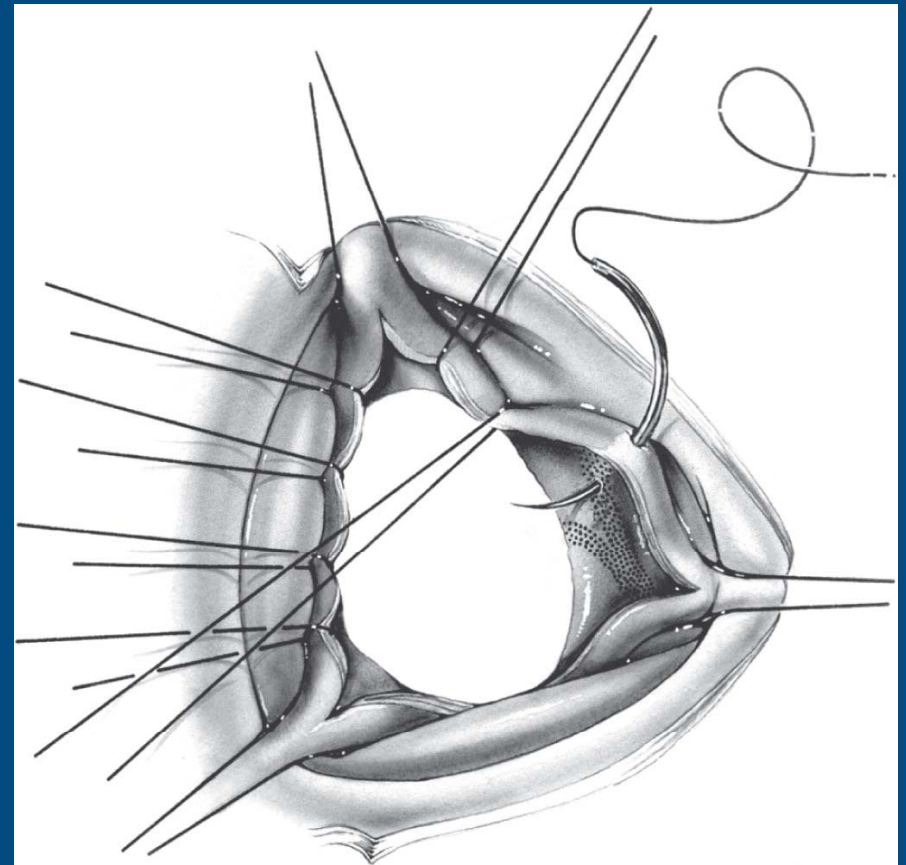
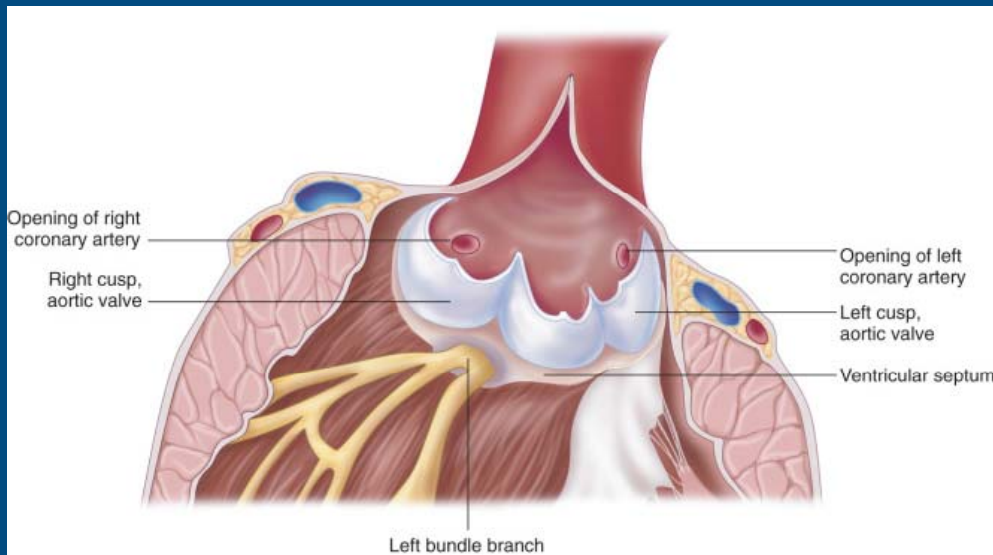
Conduction System





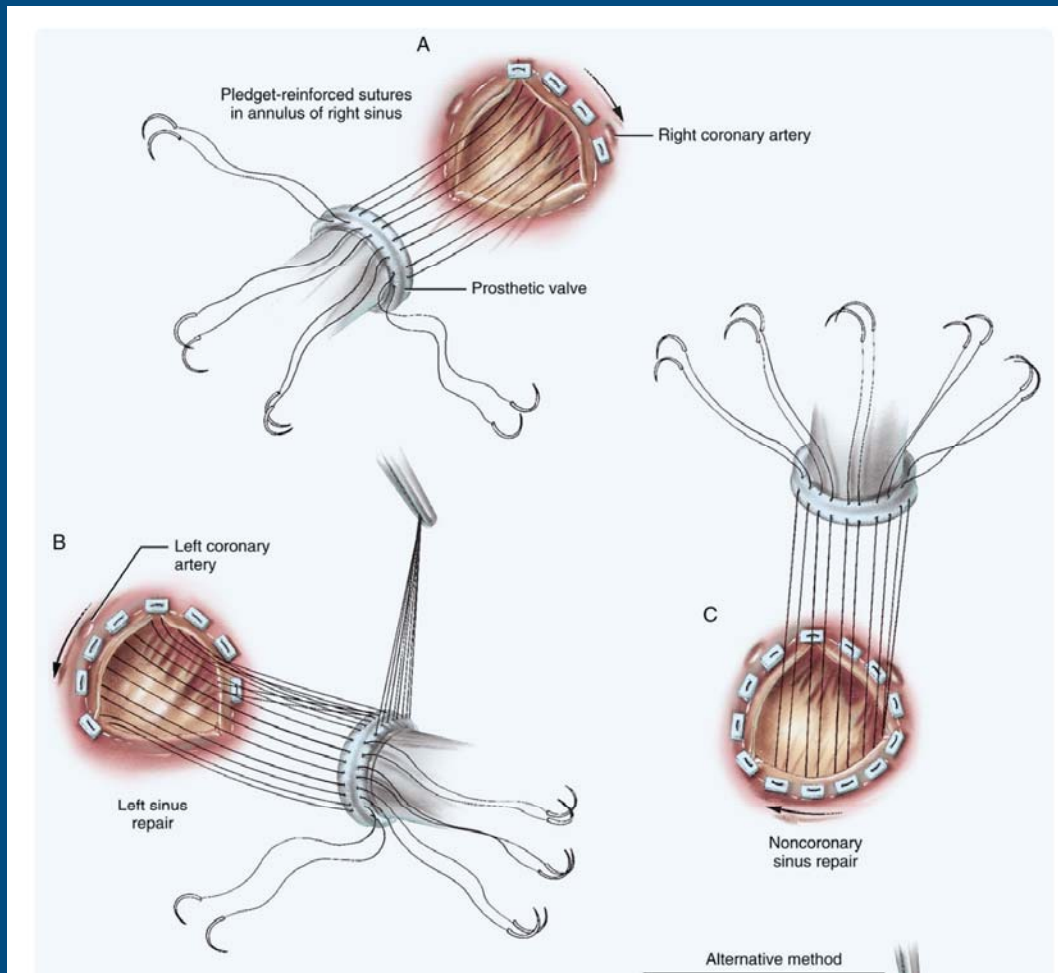
# How to Perform the Conventional Aortic Valve Replacement

## Conduction System Injury

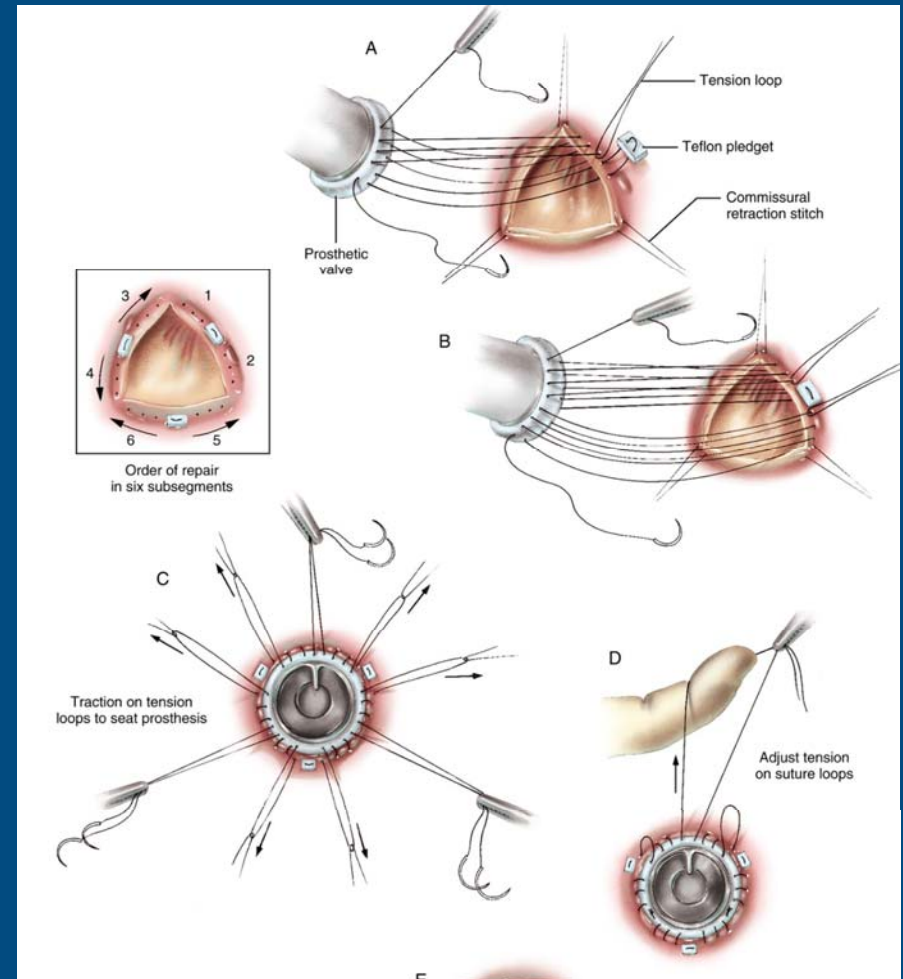


# How to Perform the Conventional Aortic Valve Replacement

## Interrupted suture technique

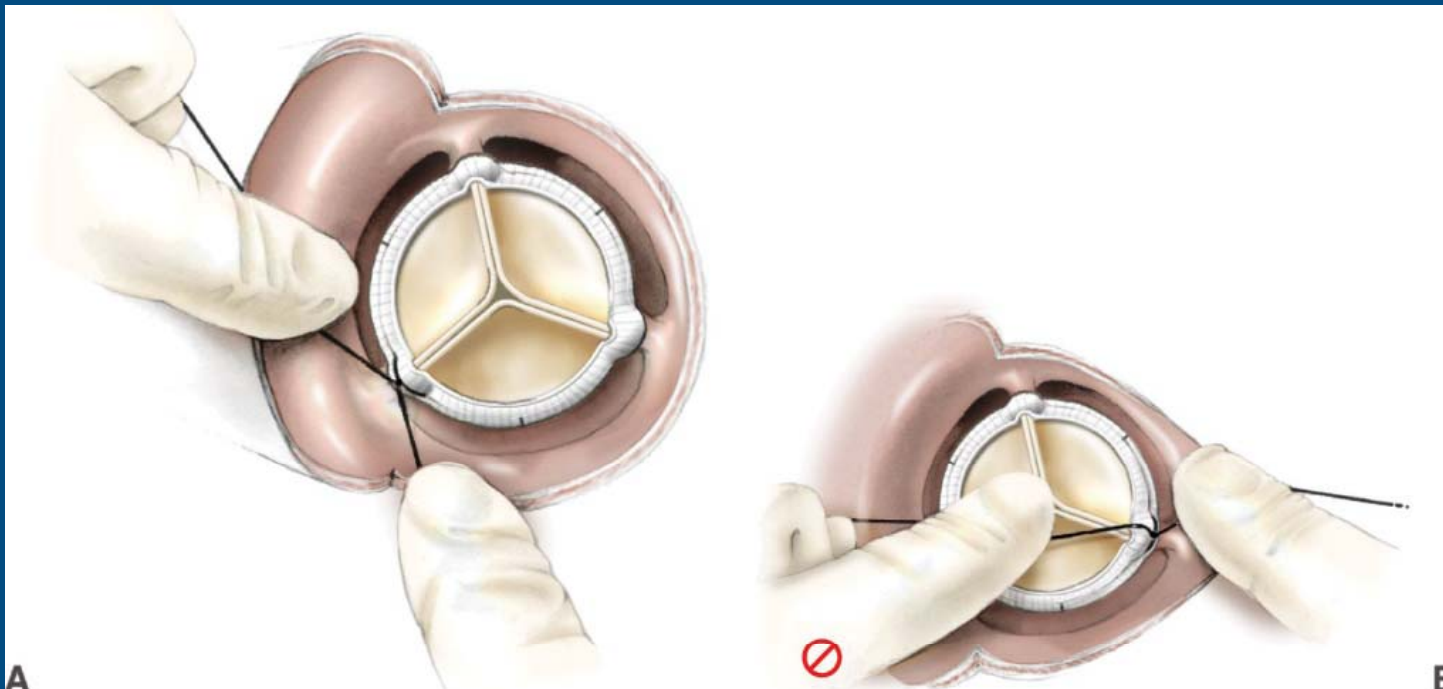


## Continuous suture technique



# How to Perform the Conventional Aortic Valve Replacement

Tying sutures down parallel with the direction of the sewing ring

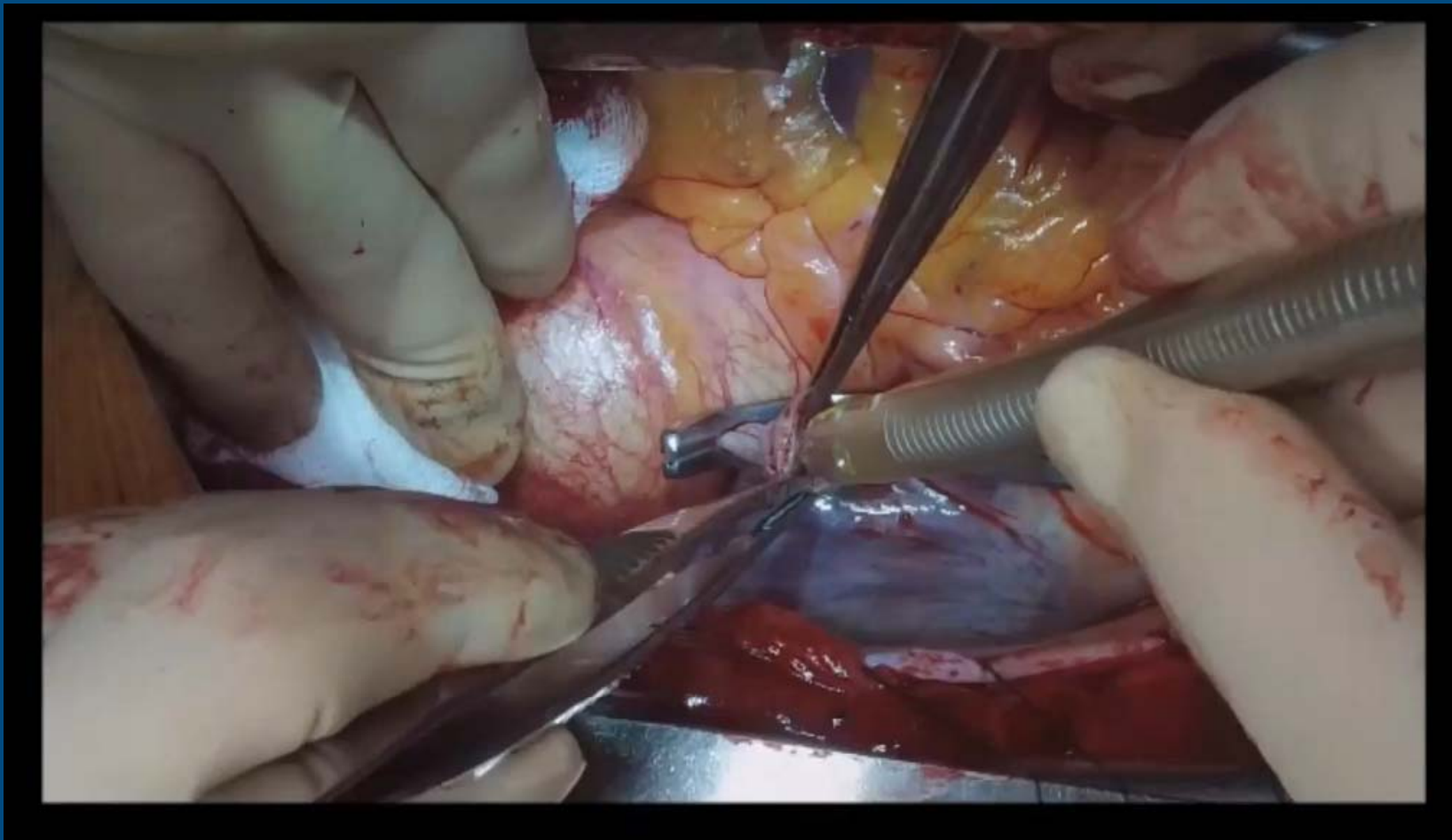


*Cor-Knot device*



# How to Perform the Conventional Aortic Valve Replacement

Video

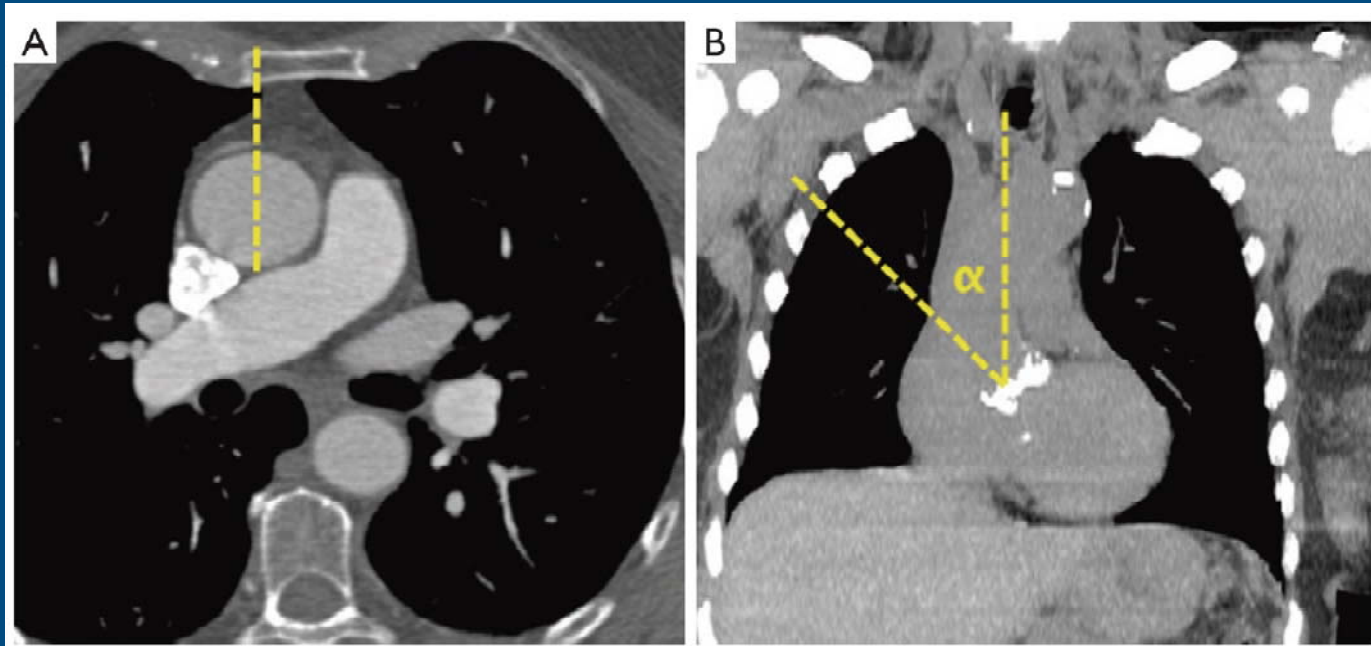


# Considering Factors for surgical AVR - MICS

|           | Right anterior thoracotomy  | J shaped hemisternotomy   |
|-----------|---|---|
| Incision  | Second intercostal space 5–6 cm: sternal sparing approach   | Midline sternal incision up to third or fourth intercostal space  |
| Inclusion | Aorta must should be more than half on the right side of parasternal line   | Aorta on the midline or central aorta close to sternum  |
| Exclusion | Ascending aorta aneurysm, associated CABG   | CABG, mitral/tricuspid valve repair replacement   |
| Exposure  | Surgical field exposure could be ameliorated using soft tissue retractor and rib retractor, seldom rib disarticulation is necessary | Pericardial stay suture could be pulled towards skin incision and loaded behind sternal retractor blade to better expose surgical field |

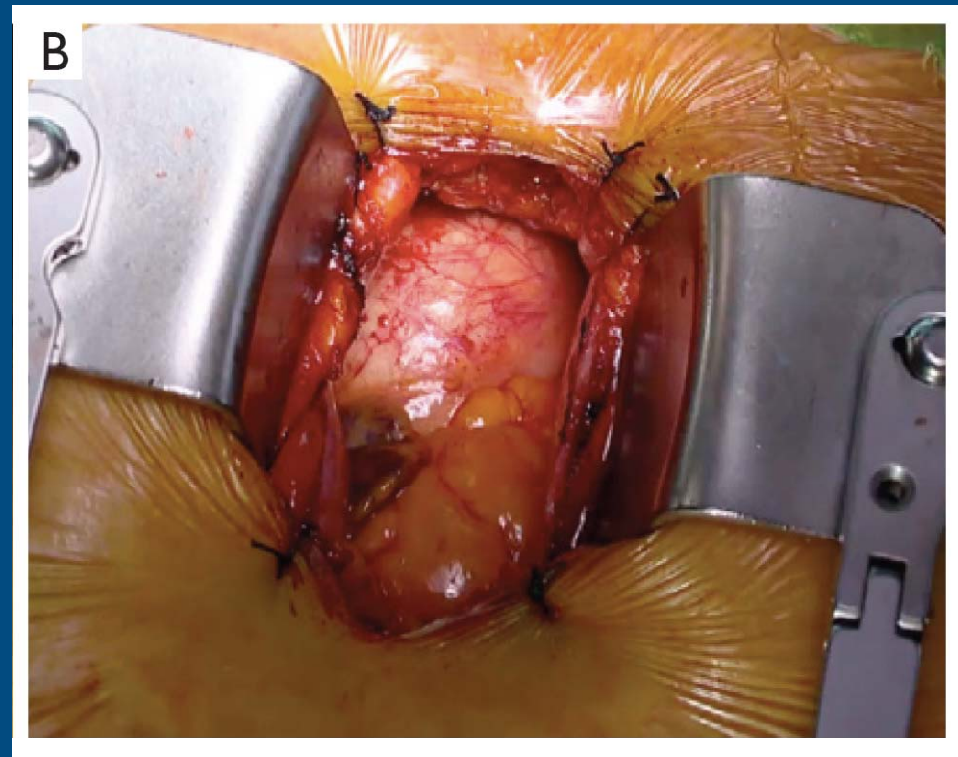
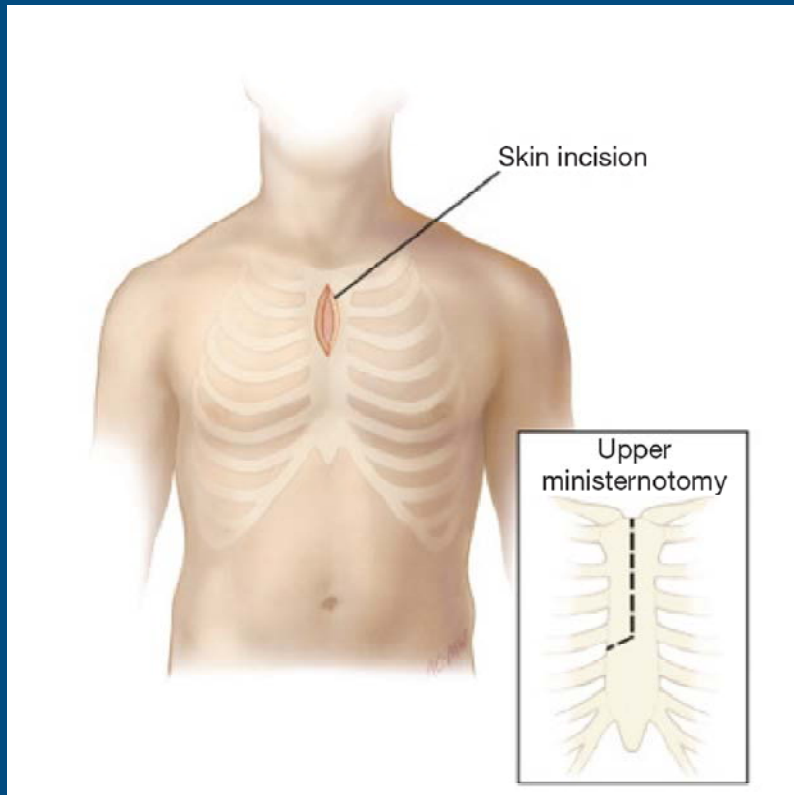
# Considering Factors for surgical AVR - MICS

- ✓ RAT is more favorable if:
  - More than one-half of ascending aorta is on the right-side of right parasternal line in the axial CT view
  - The distance from the skin to the ascending aorta is inferior to 10cm (pulmonary artery bifurcation level)
  - The angle between the midline and ascending aorta axis is  $>45^\circ$



# Considering Factors for surgical AVR - MICS

## J shaped hemisternotomy



# Considering Factors for surgical AVR - MICS

## Operative procedure

- hemisternotomy
- Pump start : A line (ascending aorta), V line (SVC, IVC – femoral vein), cardioplegia (antegrade, retrograde, direct)
- Aortotomy
- Leaflet excision and decalcification
- Annular suture
- Valve sewing ring suture
- Tying down
- Aortotomy closure (double layers : horizontal mattress suture + over- and over suture)

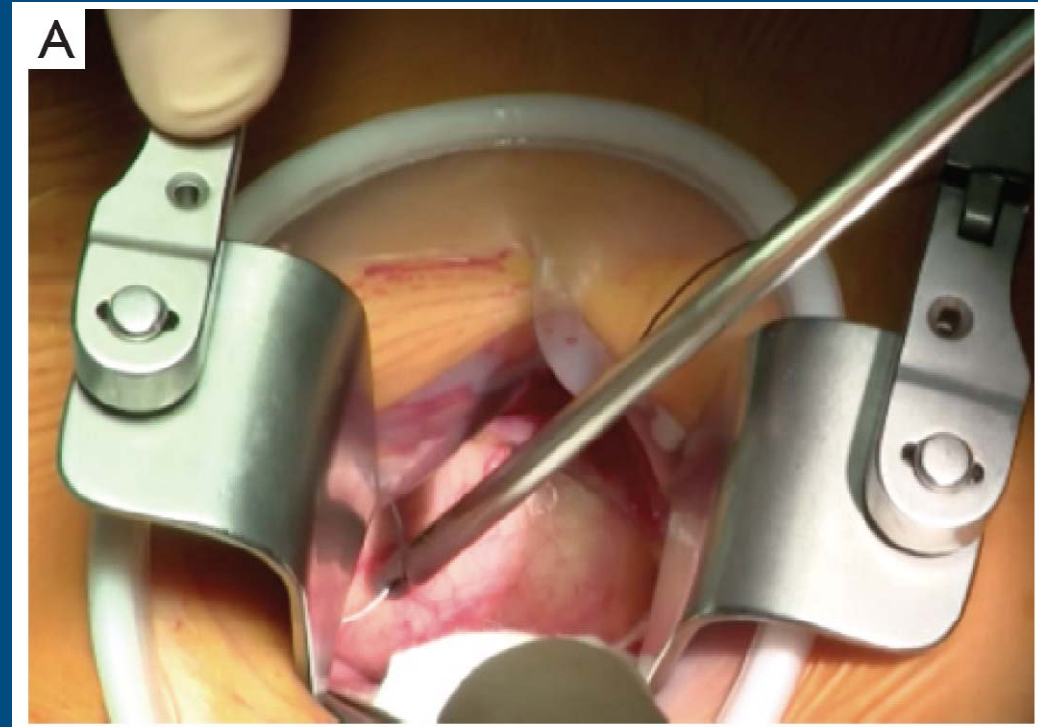
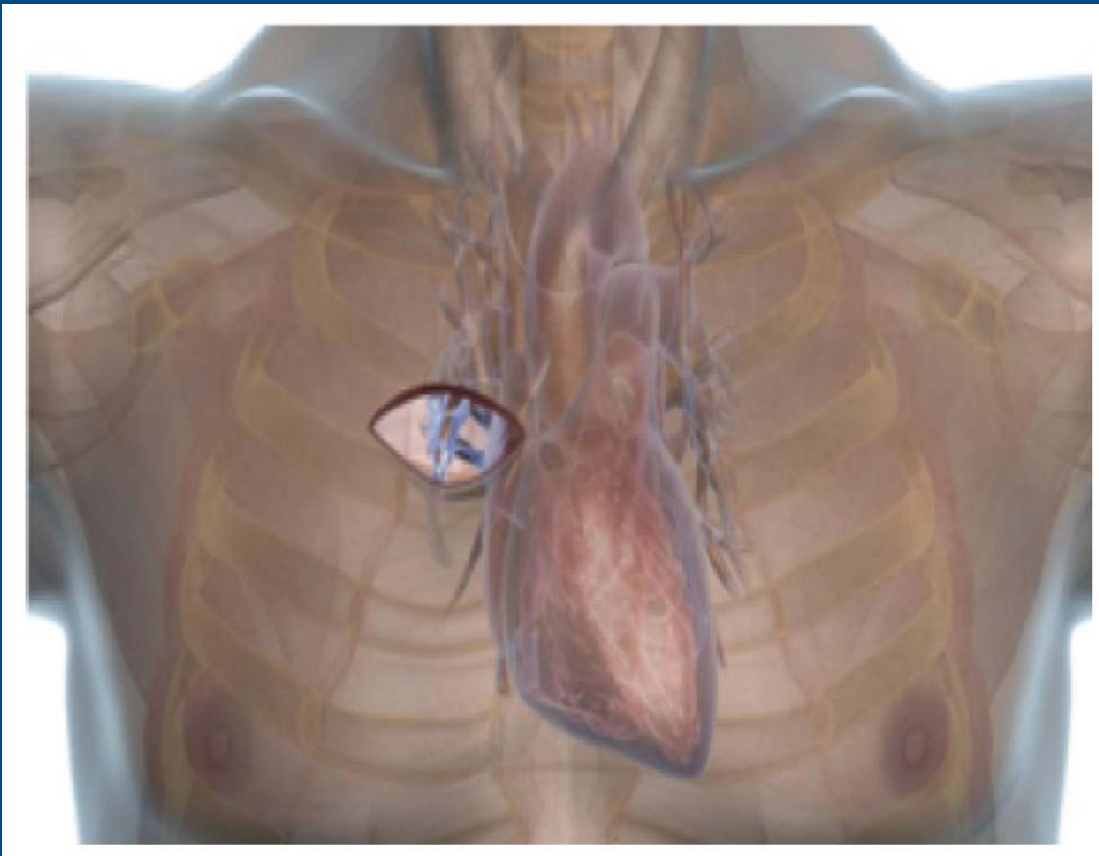


Rapid deployment or  
sutureless Valve



# Considering Factors for surgical AVR - MICS

Right anterior thoracotomy



# Considering Factors for surgical AVR - MICS

## Operative procedure

- Rt. Ant. Thoracotomy (2<sup>nd</sup> or 3<sup>rd</sup> ICS)
- Pump start : A line (femoral a.), V line (SVC – jugular vein, IVC – femoral vein), cardioplegia (antegrade, retrograde, direct)
- Aortotomy
- Leaflet excision and decalcification
- Annular suture
- Valve sewing ring suture
- Tying down
- Aortotomy closure (double layers : horizontal mattress suture + over- and over suture)



Rapid deployment or  
sutureless Valve

# Considering Factors for surgical AVR - MICS

Video



# Considering Factors for surgical AVR - anatomy

- ✓ Aorta, root, annulus and leaflet calcification
  - Aortotomy site, clamp site, decalcification
- ✓ Aorta, ST junction, annulus size
  - 19mm CE valve outer diameter 24mm →  $22 \times 3.14 = 69.08$  mm (perimeter >70mm)
  - Annular enlargement procedure (수술 전 가능성 고려)
- ✓ Bicuspid, ascending aorta aneurysm – MICS ?
- ✓ Origin of coronary artery (high take-off RCA 주의) → 수술 전 CT 확인
- ✓ Course of coronary (direct cardioplegia 주입 시 주의) → 수술 전 coronary course 확인

# Conclusions

- ✓ 대동맥 판막 수술의 적응증을 이해한다.
  - Severe AS or AR ± symptom
- ✓ 대동맥 판막의 해부학적 특성을 이해한다.
  - Conduction system, membranous septum
- ✓ 대동맥 판막 치환술의 방법을 이해한다.
  - 본인만의 routine procedure를 만들자. 시작은 모방에서 부터...
- ✓ 대동맥 판막 치환술을 시행할 때 고려해야할 상황을 이해한다.
  - Anatomy를 고려한 수술 계획을 세우자.