

A decorative graphic on the left side of the slide, consisting of a network of white lines and circles that resemble a circuit board or a stylized tree structure. The lines are vertical and horizontal, with small circles at various points, creating a complex, branching pattern.

# AORTIC ROOT DISEASE

ALI ALAMERI MD

A decorative graphic on the left side of the slide, consisting of a network of white lines and circles on a blue background, resembling a circuit board or a stylized tree structure.

# AORTIC ROOT ANEURYSM

# HISTORY

## Milestones in the History of Cardiac Surgery

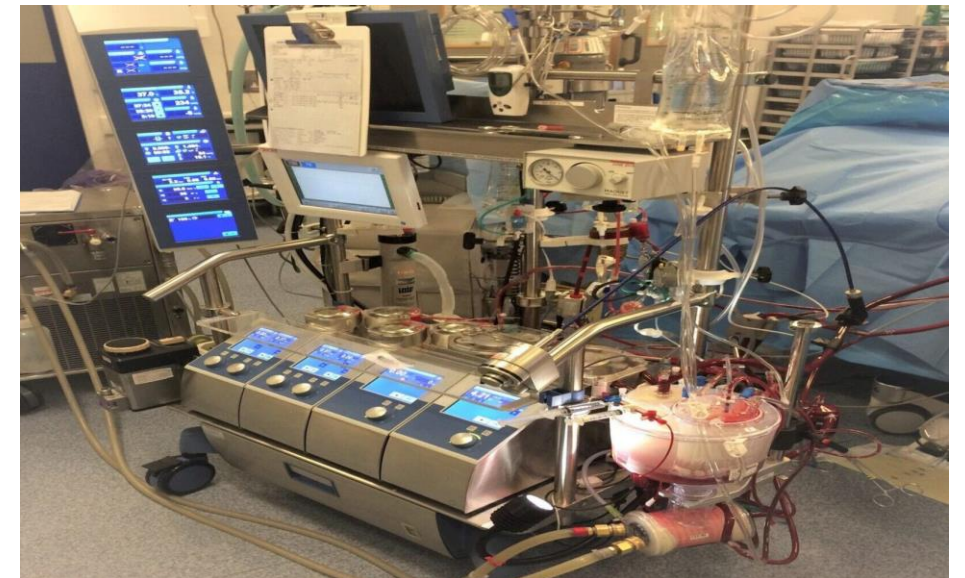
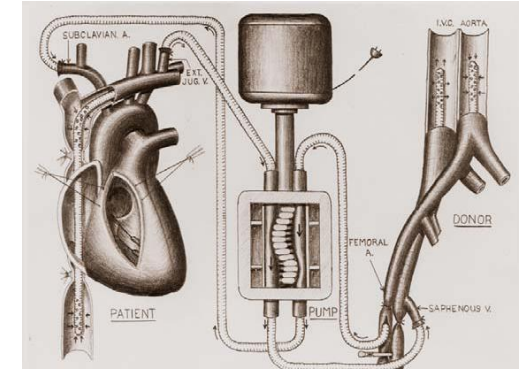
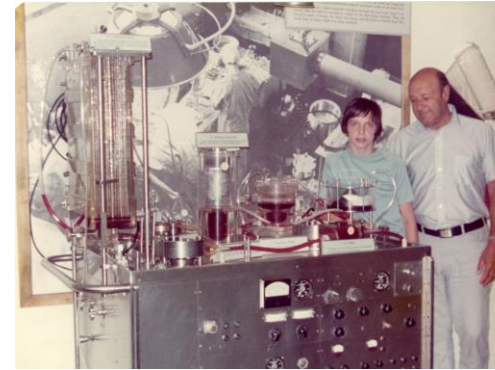
### Early Beginnings:

- **1896** – **Dr. Ludwig Rehn** (Germany) performs the first successful open heart surgery: repair of a stab wound to the heart.
- **1912** – **Dr. Robert Gross** (USA) performs the first successful ligation of a patent ductus arteriosus (PDA) in a child.

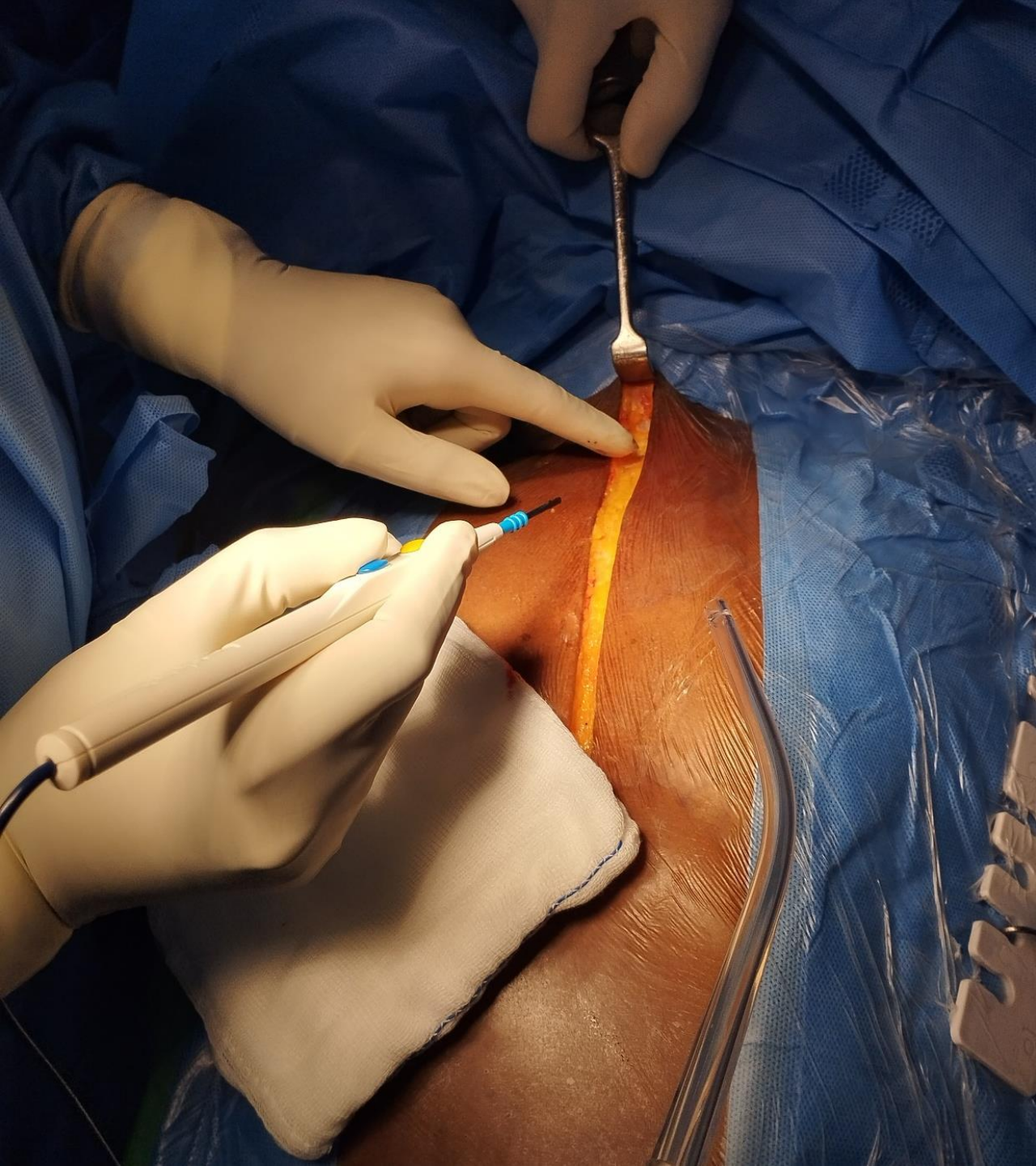
### Development of Cardiac Surgery Techniques:

- **1930s-1940s** – Introduction of **cardiopulmonary bypass (CPB)** by **Dr. John Gibbon** (USA), allowing for open heart surgery with circulatory support.
- **1953** – First successful open-heart surgery using CPB performed by **Dr. Gibbon** to correct aortic valve stenosis.

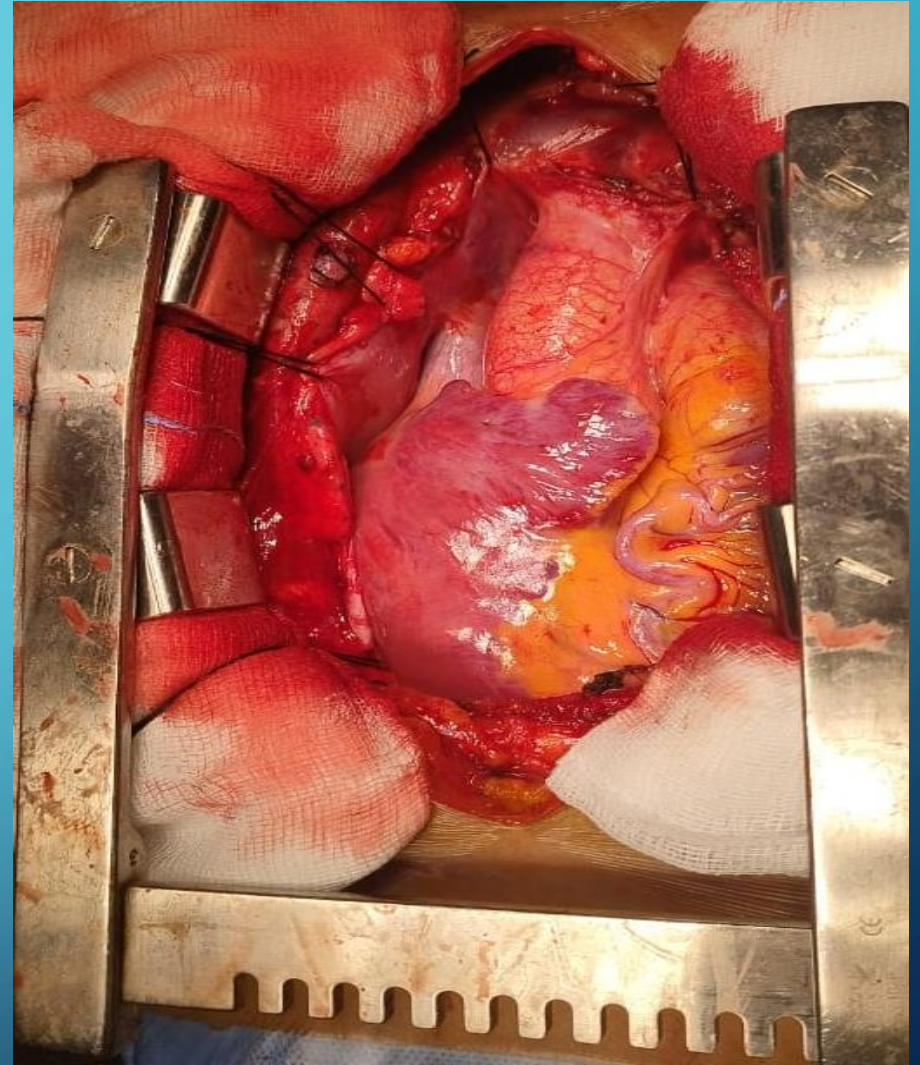
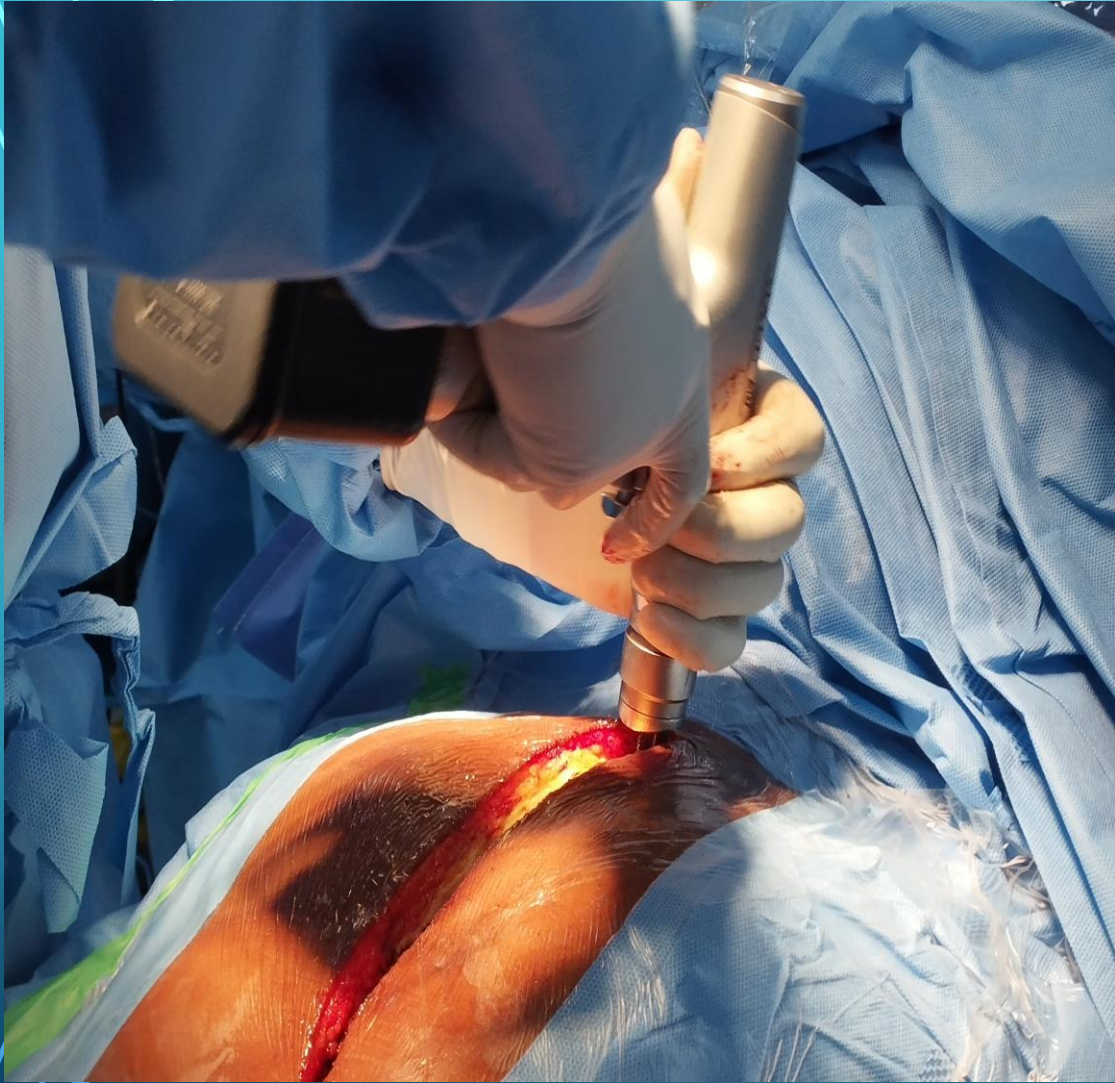
# BYPASS MACHINE EVOLVEMENT





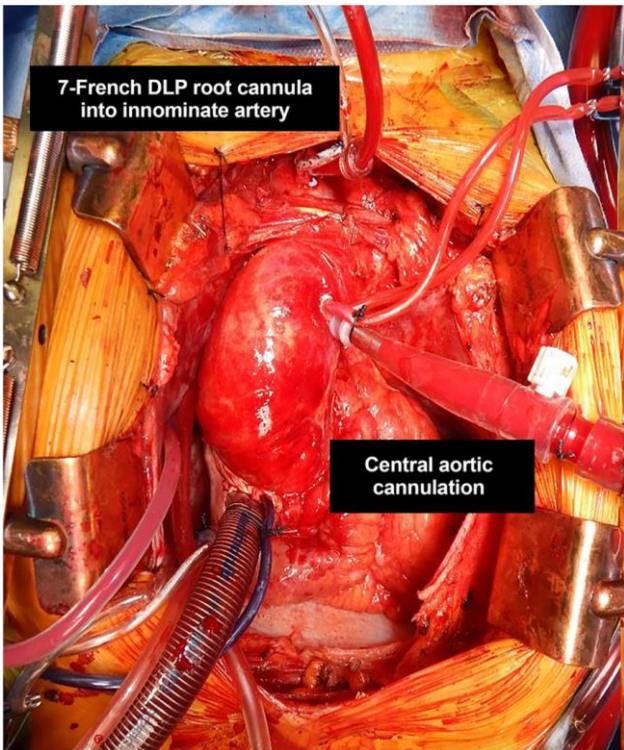
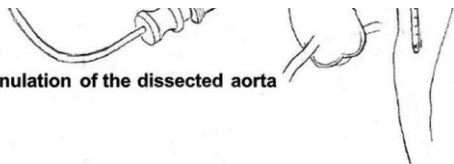






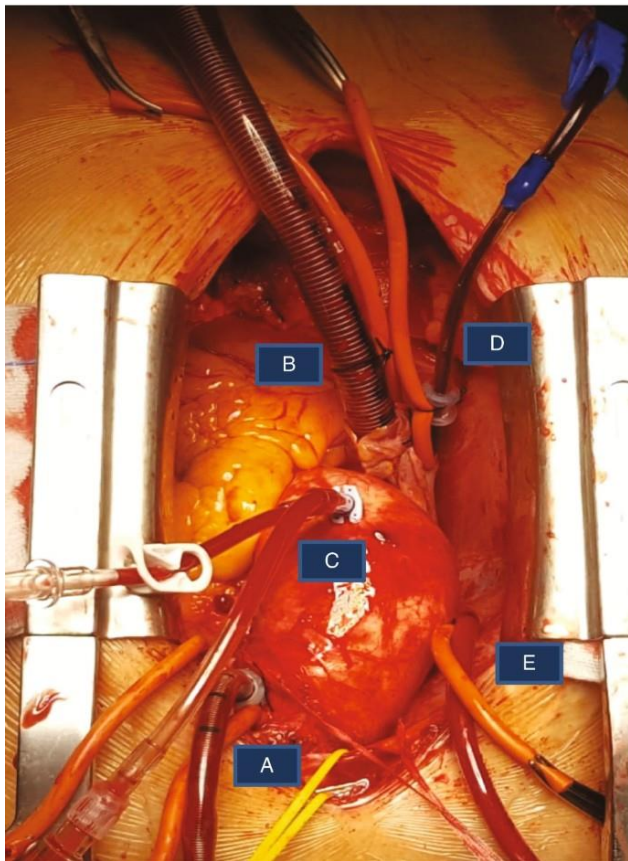


Central cannulation of the dissected aorta



7-French DLP root cannula into innominate artery

Central aortic cannulation



# CANNULATION

# HISTORY

Michael DeBakey Lebanese American 1908-2008

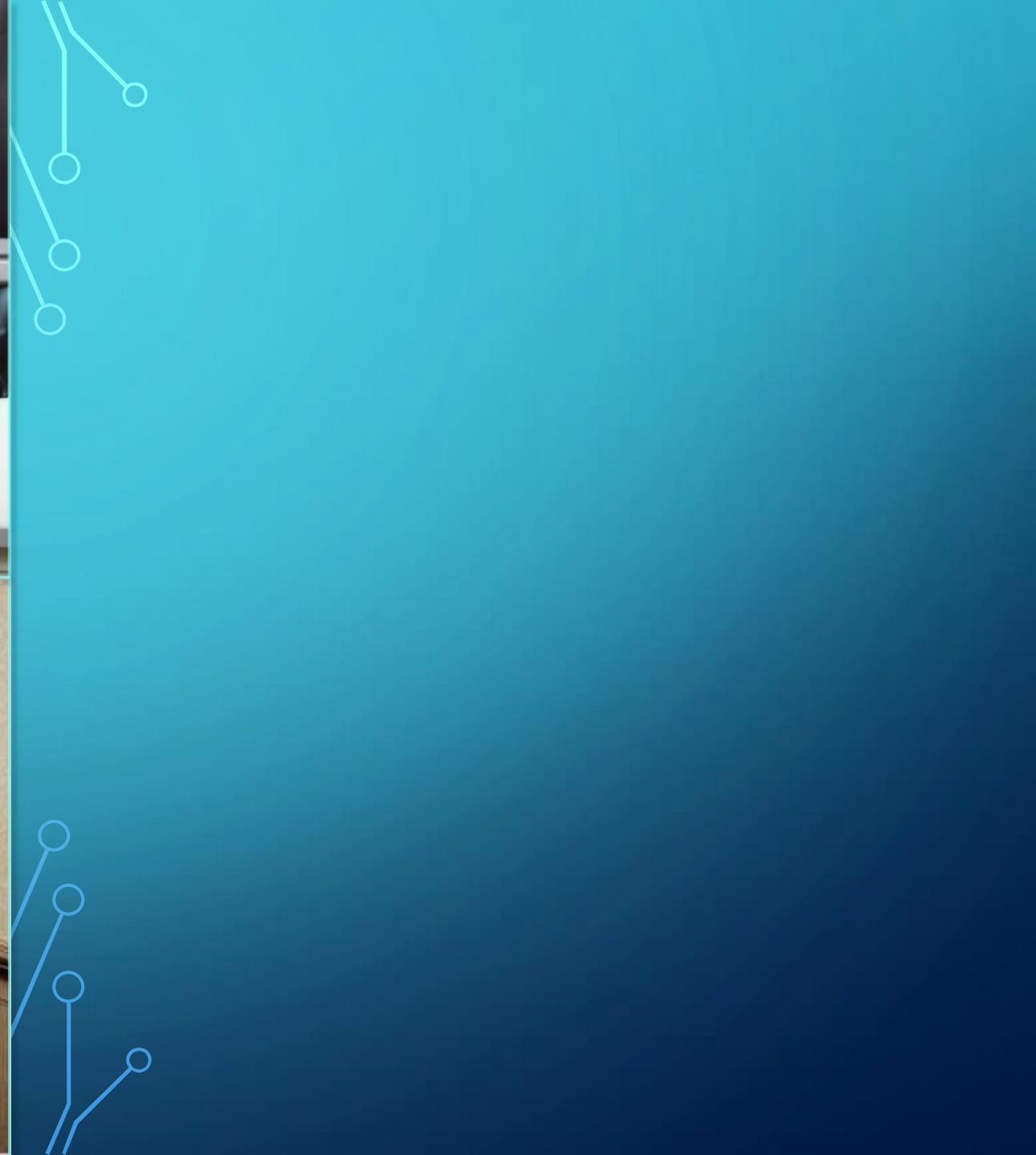
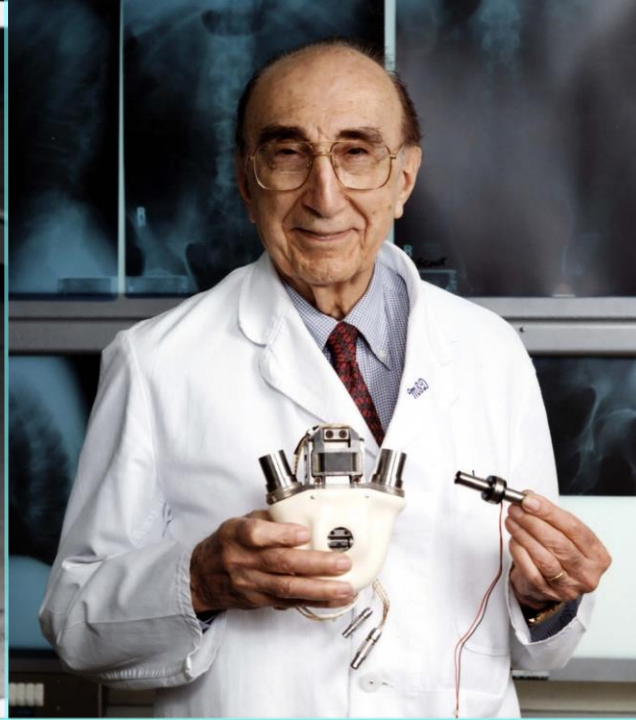
Development of the DeBakey Aortic Prosthesis: (Dacron graft)

DeBakey's Artificial Heart

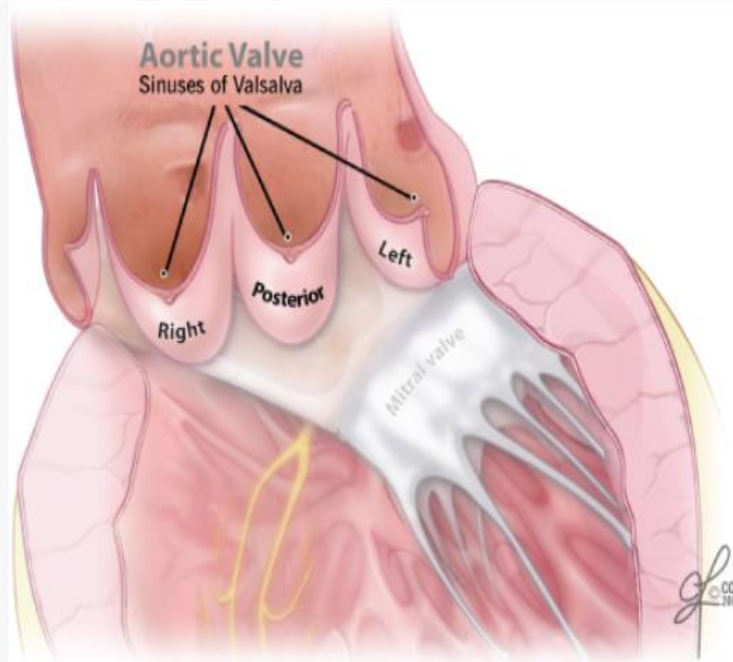
He performed over 60,000 operations during his career

In 2005 he suffered type A Aortic dissection



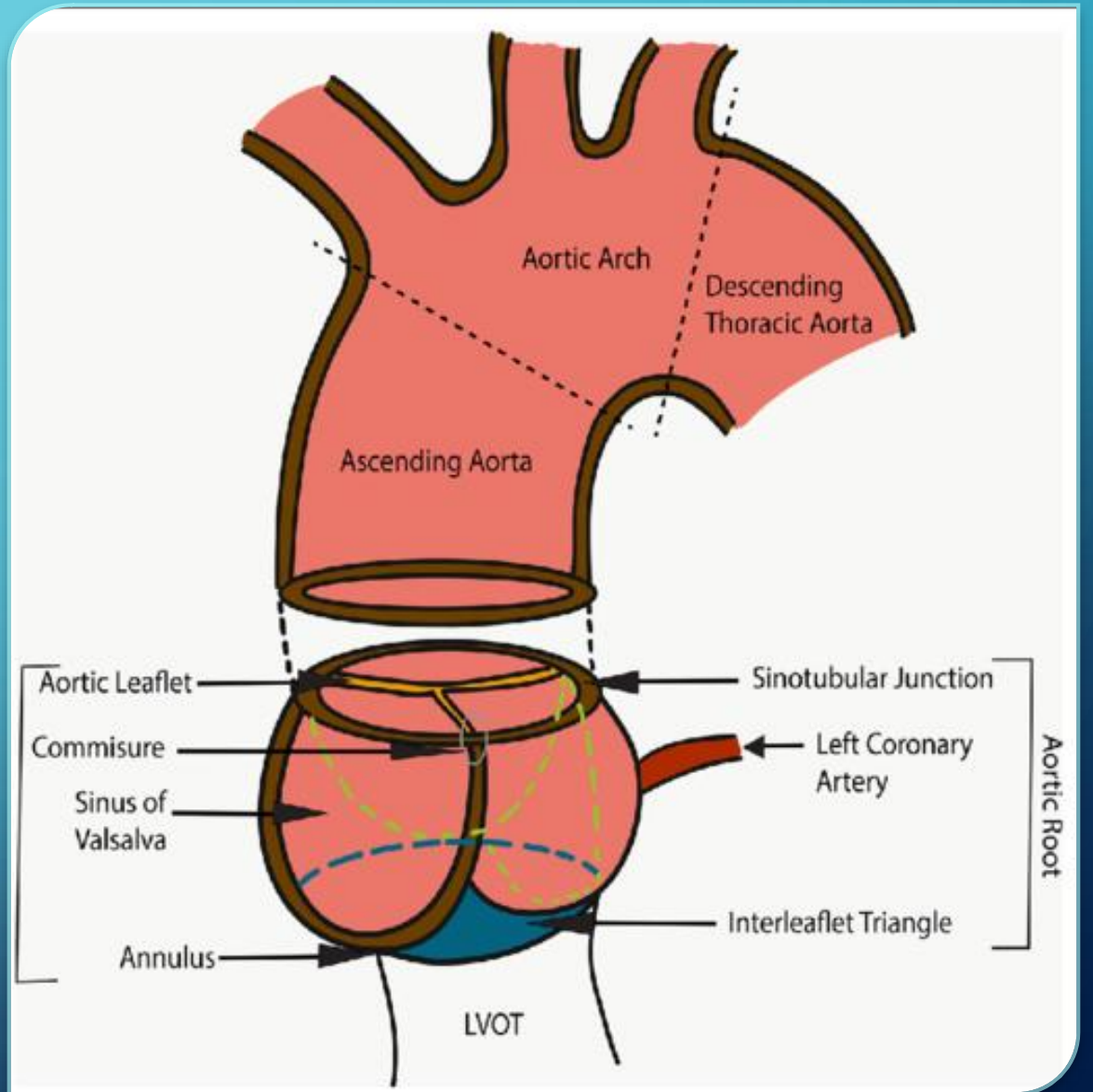


# ANATOMY

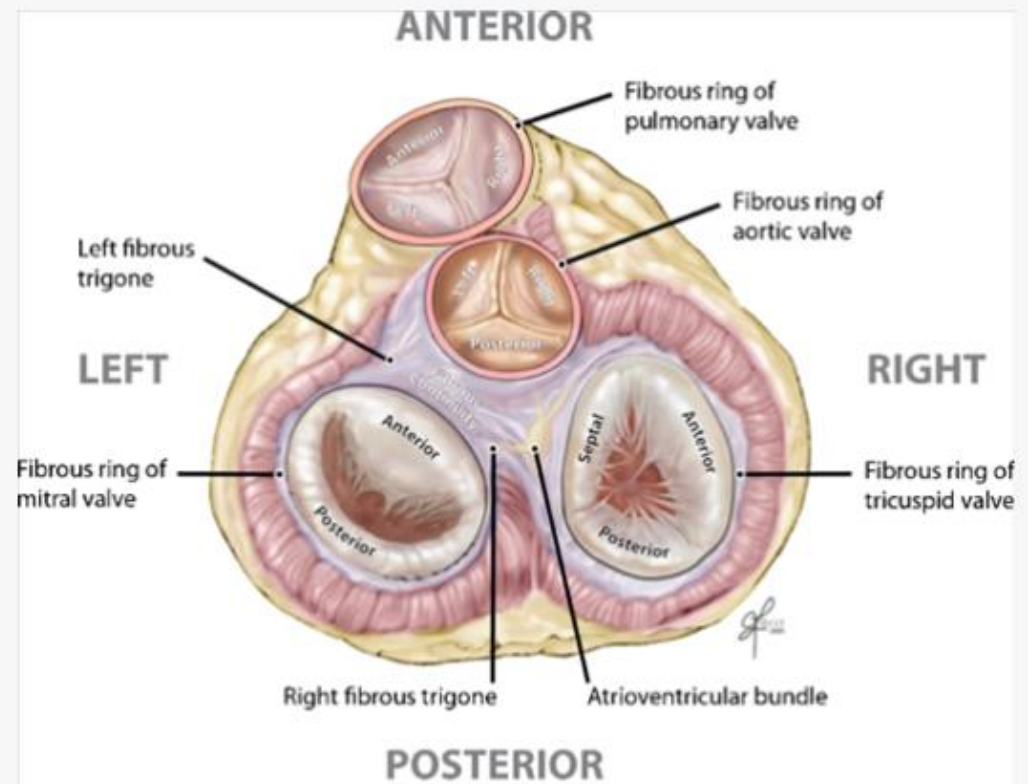


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# PATHOPHYSIOLOGY OF AORTIC ROOT ANEURYSM



## Definition:

An aortic root aneurysm refers to an abnormal dilation of the aortic root, the segment of the aorta that includes the aortic valve and its supporting structures.



## Key Mechanisms:

### Structural Weakening of the Aortic Wall:

- Loss of integrity in the elastin and collagen fibers within the aortic wall





## **Hemodynamic Stress:**

Elevated blood pressure or high-flow states increase stress on the aortic root, contributing to wall thinning and dilation.



## **Disturbance of Aortic Valve Function:**

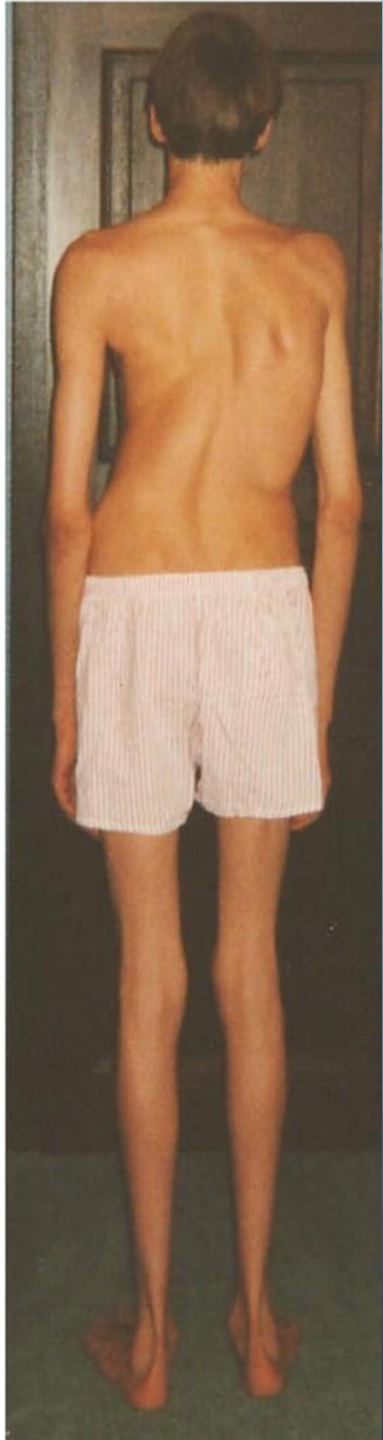
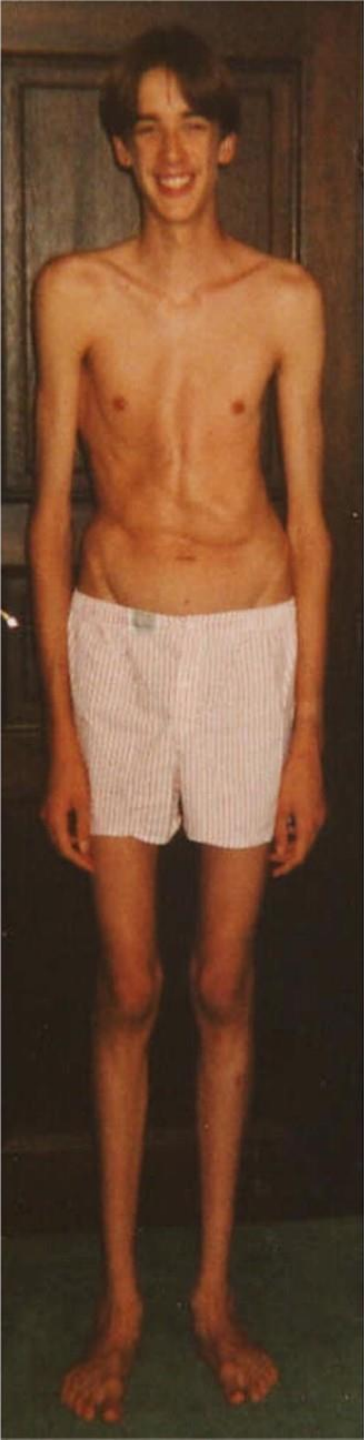
Dilation of the aortic root can lead to aortic valve insufficiency, exacerbating hemodynamic abnormalities.



# ETIOLOGY

- **Genetic Conditions:**
  - **Marfan Syndrome (FBN1 mutation):**
    - Weak connective tissue, commonly resulting in aortic root aneurysms.
  - **Ehlers-Danlos Syndrome (Type IV):**
    - Defective collagen synthesis, causing arterial fragility and increased risk of aortic aneurysms.
  - **Loeys-Dietz Syndrome:**
    - Mutations in TGFBR1 or TGFBR2, leading to aggressive aneurysms and vascular abnormalities.







# LOEYS-DIETZ SYNDROME





- **Bicuspid Aortic Valve (BAV):**

- Present in up to 50% of cases of aortic root aneurysm. The altered valve function leads to aortic root dilation and predisposes to aneurysms over time.
- Other acquired conditions atherosclerosis, hypertension, infection and advanced age

# IMAGING

CTA gold standard

```
graph TD; A[CTA gold standard] --> B[TTE and TEE for aneurysm and valve function]; B --> C[MRA if CT is contraindicated];
```

TTE and TEE for aneurysm and valve function

MRA if CT is contraindicated

# SCREENING

Indicated in all  
first-degree  
relatives of the  
patient

Genetic testing  
in patients with  
Aneurysms

Echo and or  
CT/MRI annually



# INDICATIONS FOR SURGICAL INTERVENTION IN AORTIC ROOT ANEURYSM



## Aortic Root Diameter:

**$\geq 4.5-5$  cm** in patients with **Marfan syndrome, Ehlers-Danlos or concomitant surgery**

**$\geq 5-5.5$  cm** in patients without genetic syndromes.

Consider earlier intervention if there is rapid growth ( $\geq 0.5$  cm/year).




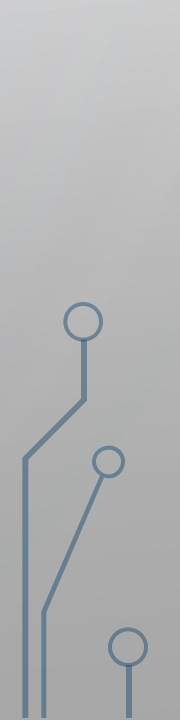
## Symptomatic Patients:

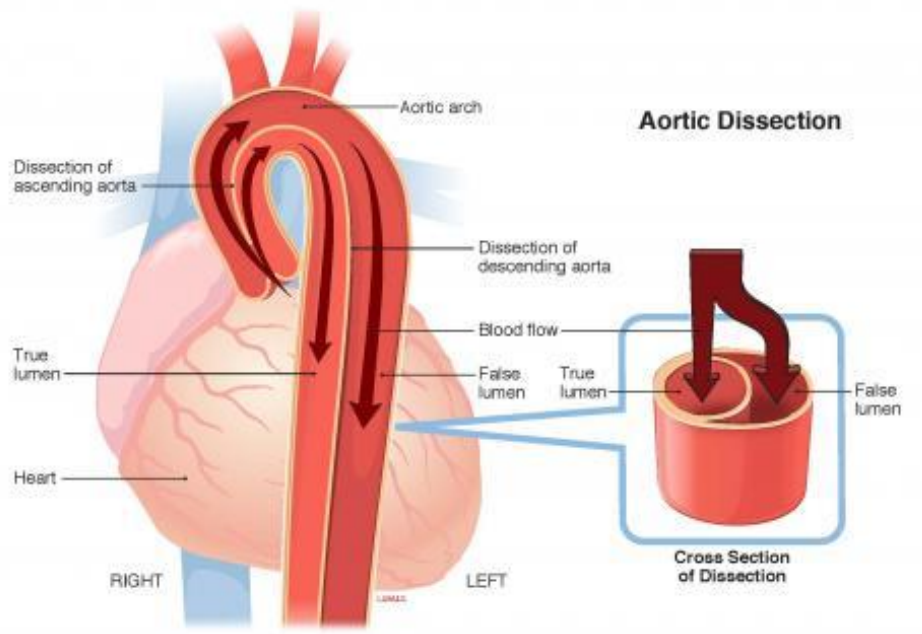
**Chest pain, back pain, etc**

**Aortic regurgitation (severe) or progressive valve insufficiency with symptoms.**



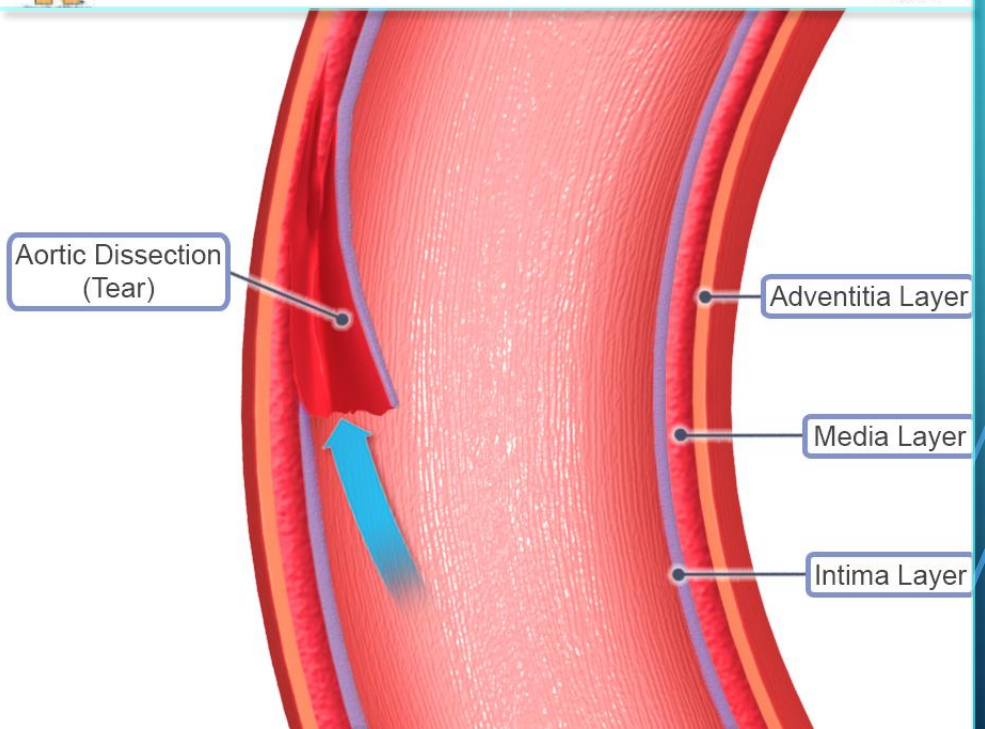
- **Other Considerations:**

- **Bicuspid aortic valve (BAV):** Surgery is considered at aortic root diameters  $\geq 5$  cm due to the high risk of progressive dilation.
  - **Genetic conditions** (Marfan, Loeys-Dietz, Ehlers-Danlos) may prompt earlier intervention despite smaller aneurysm size due to risk of rupture or dissection.
- 
- 



# AORTIC DISSECTION

- **Aortic dissection** is a life-threatening condition where there is a tear in the intima of the aortic wall, allowing blood to dissect between the layers of the vessel and creating a false lumen.





# TYPES OF AORTIC DISSECTION:

## Stanford classification:

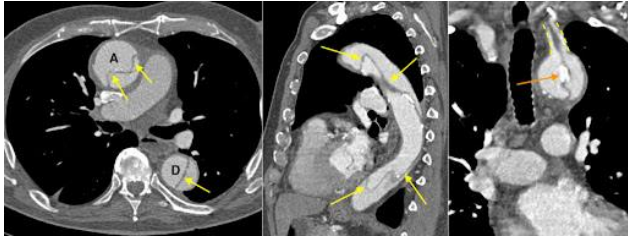
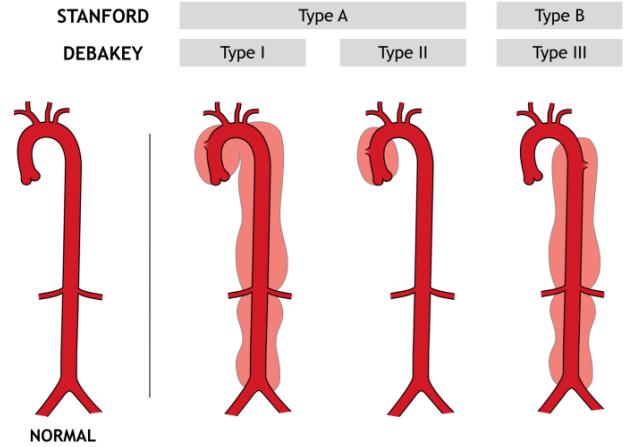
### 1. Type A (Acute):

1. Involves the **ascending aorta** (includes the aortic arch).
2. Requires **emergency surgery** due to the high risk of rupture or cardiac tamponade.

### 2. Type B:

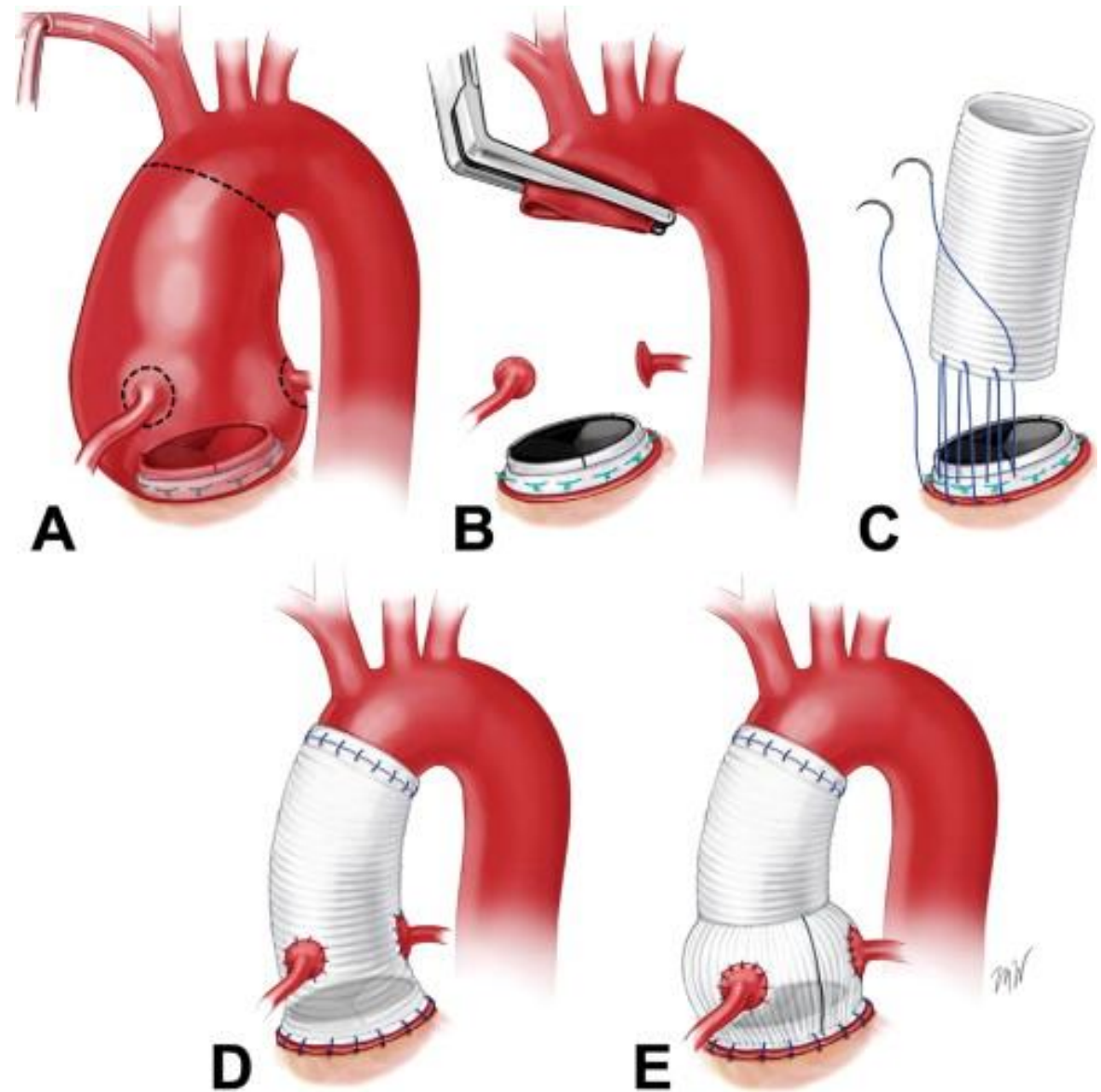
1. Involves the **descending aorta** (below the left subclavian artery).
2. May be managed **medically** in stable patients or surgically if complications arise (e.g., rupture, organ malperfusion).

# DE BAKKEY CLASSIFICATION

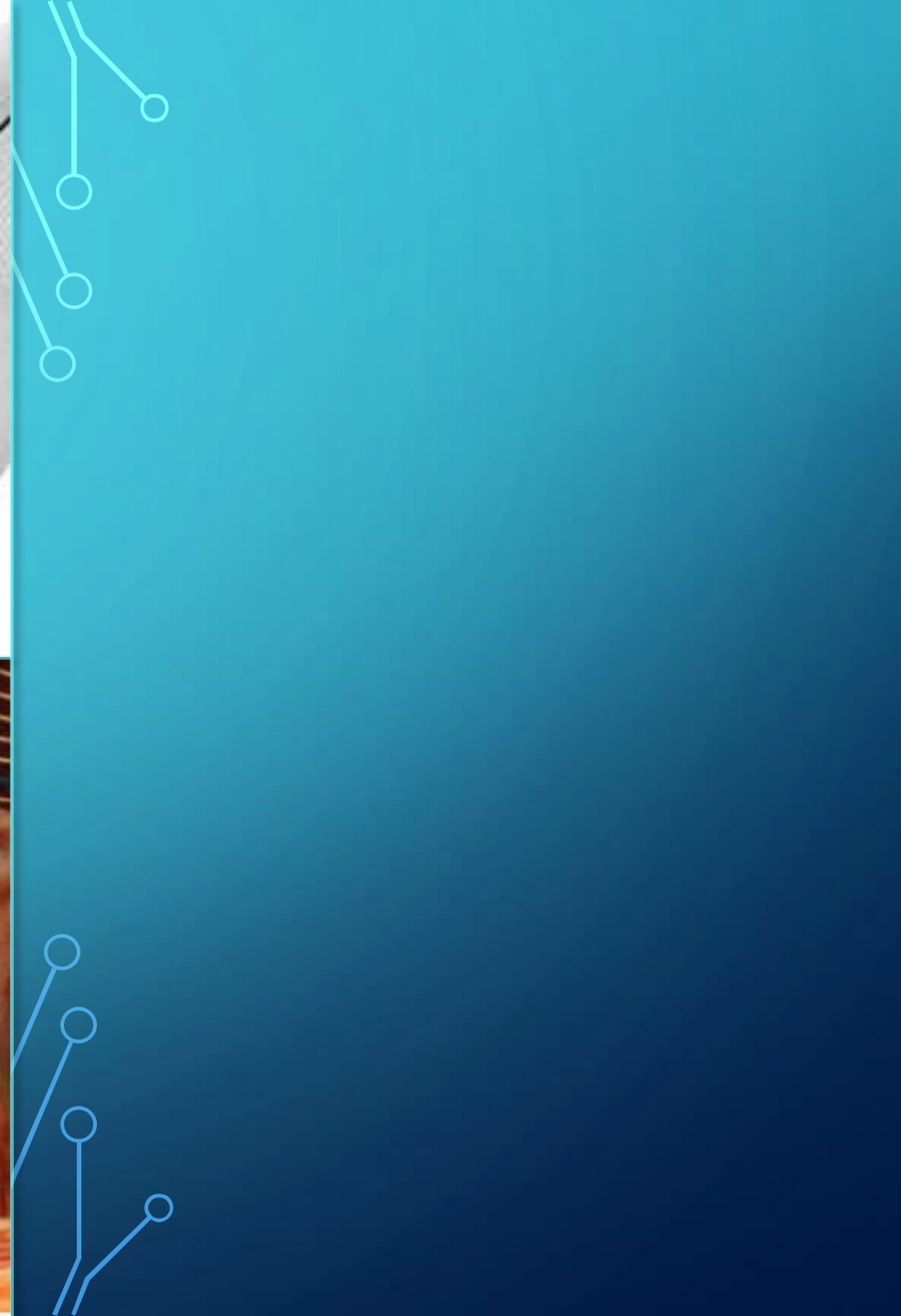
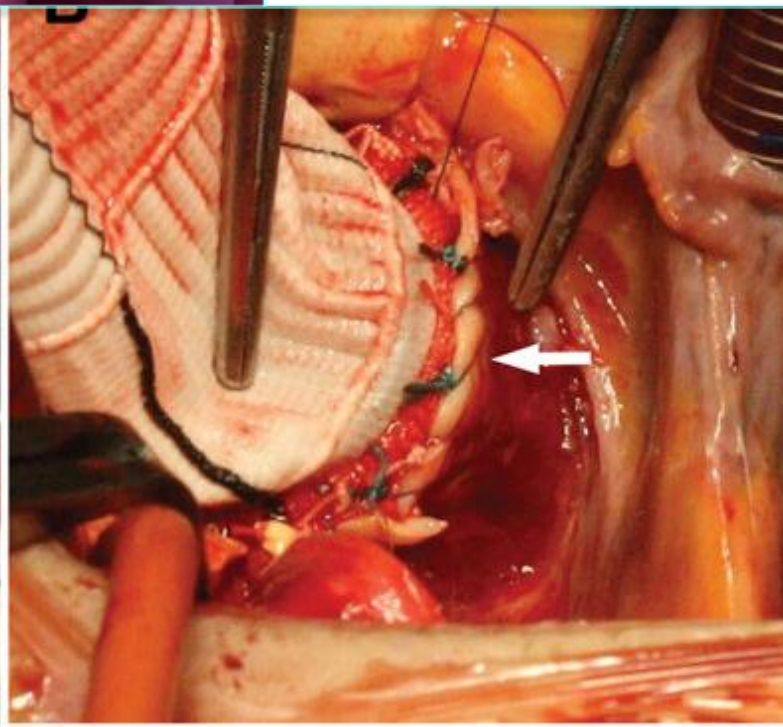
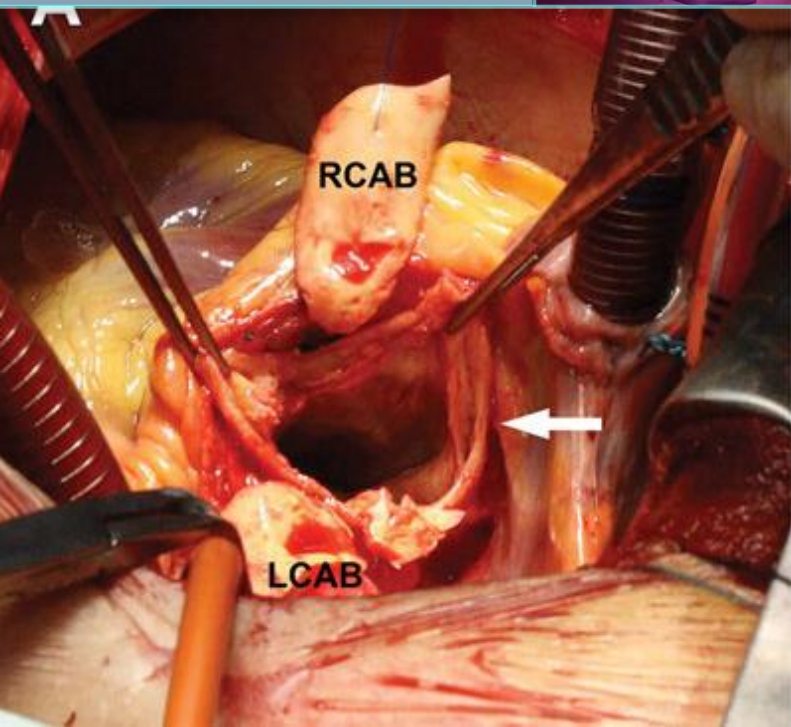


# SURGICAL REPAIR

- Aortic root replacement (Bentall procedure) :
  - Bioprosthesis >60 or mechanical <60







# VALVE SPARING AORTIC ROOT REPLACEMENT (DAVID PROCEDURE)

- FOR PATIENTS WITH AORTIC ROOT ANEURYSMS WHERE THE AORTIC VALVE IS COMPETENT



Horizontal mattress sutures without pledges are placed in one lane underneath the sinuses for later fixation of the graft to the aortic root.



When knots of the horizontal mattress are gently tied, the graft must be pushed down and held in position by the assistant.

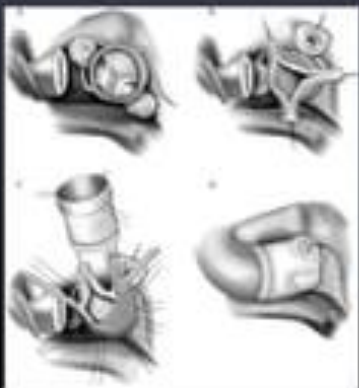


A pivotal step of the reimplantation procedure is the positioning of the commissures high enough into the Dacron tube by pulling on the stay sutures, reshaping a correct geometry of the valve.



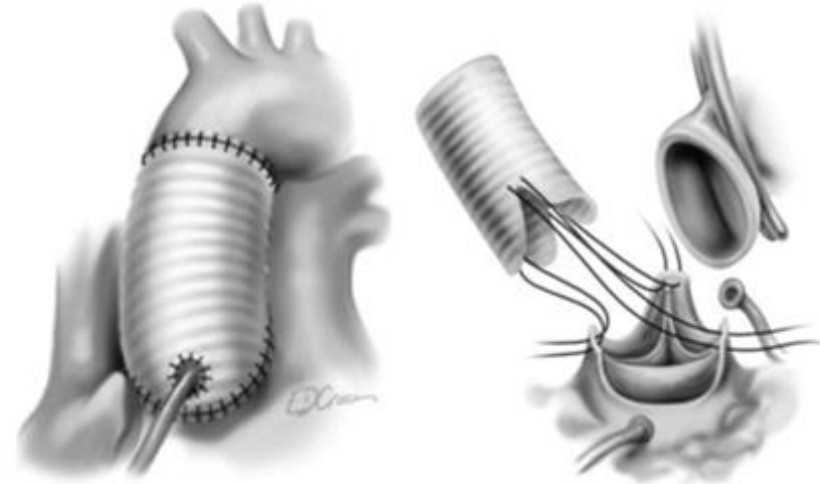
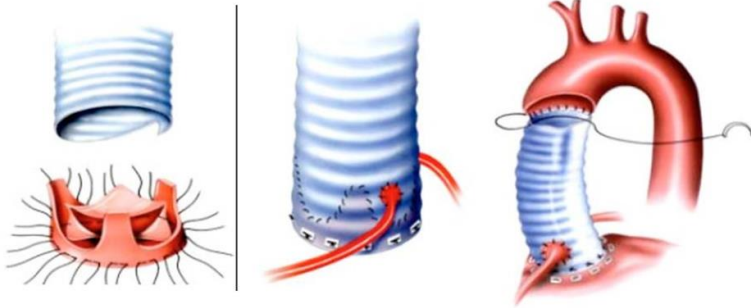
## Valve-sparing aortic root replacement: the inclusion (David) technique

Operative Techniques in Thoracic and Cardiovascular Surgery 2005;30(4):246-259  
David TE, Feindel CM. An aortic valve-sparing operation for patients with aortic incompetence and aneurysm of the ascending aorta. J Thorac Cardiovasc Surg 1985; 81:7-12, 1992





**“David” Procedure:  
Aortic Root replacement  
with reimplantation of Aortic Valve**

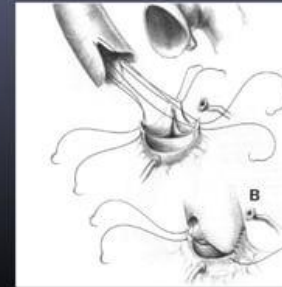


*Reprinted from Heart, Lung and Circulation, 2004;13 Suppl 3, Mitalanis G. Valve sparing aortic root repairs—an anatomical approach. S13-18, Copyright (2004), with permission from Elsevier*

**(DAVID PROCEDURE)**



# YACOUB PROCEDURE



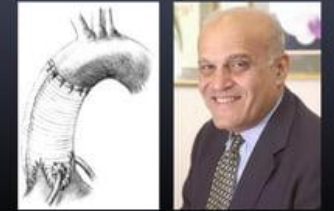
SUTURE are passed from the inside to the outside of the graft immediately above the end of the longitudinal cuts, and then from the inside to the outside of the remnants of the aortic.

The Dacron graft is then sutured to the remnants of the aortic sinuses along the aortic annulus. It is safer to start at the commissural level and to sew toward the central portion of the sinus to prevent maldistribution of the tailored graft along the aortic annulus.

The graft should lie inside the remnants of the aortic sinuses.

## Valve sparing aortic replacement – root remodeling

Operative Techniques in Thoracic and Cardiovascular Surgery  
2005;10(4):246–258



The diseased aortic sinuses are **excised down to the aortic annulus**, which is always healthy and can hold sutures securely even in patients with acute dissection.



choosing an **appropriately sized Dacron tube**, **passing** horizontal mattress sutures just above the top of each commissure and stretching the three **commissures in a vertical direction** while observing the position of the cusps.



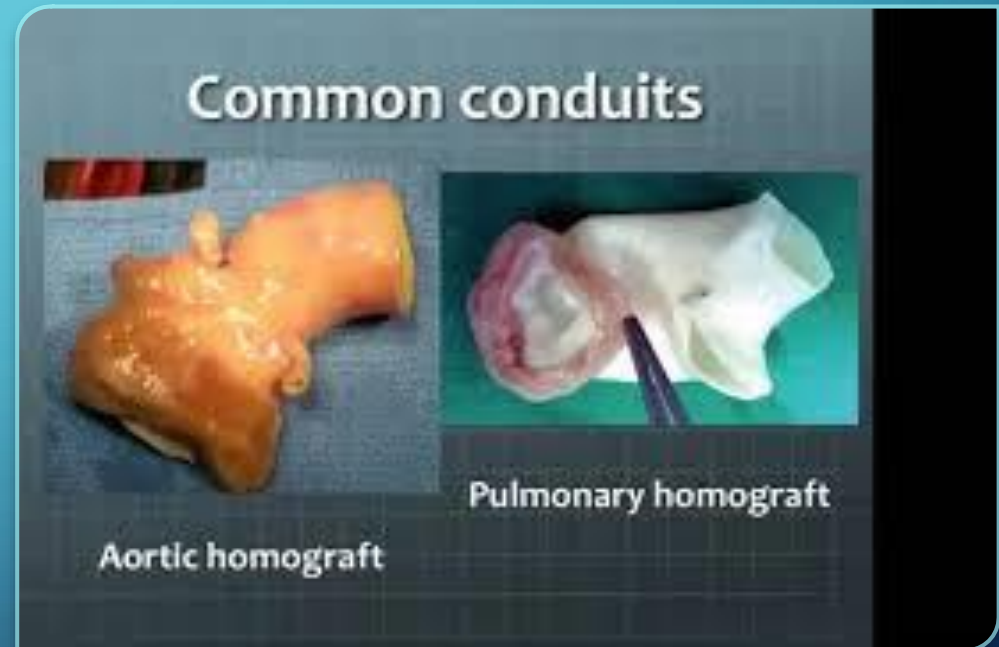
Dacron graft is tailored to conform the **shape of the 3 aortic sinuses** and then anastomosed to the aortic root.



Dacron graft is anchored to the **aortoventricular junction**. The native aortic valve is then **resuspended** within the vascular graft.

# OTHER TYPES OF CONDUITS

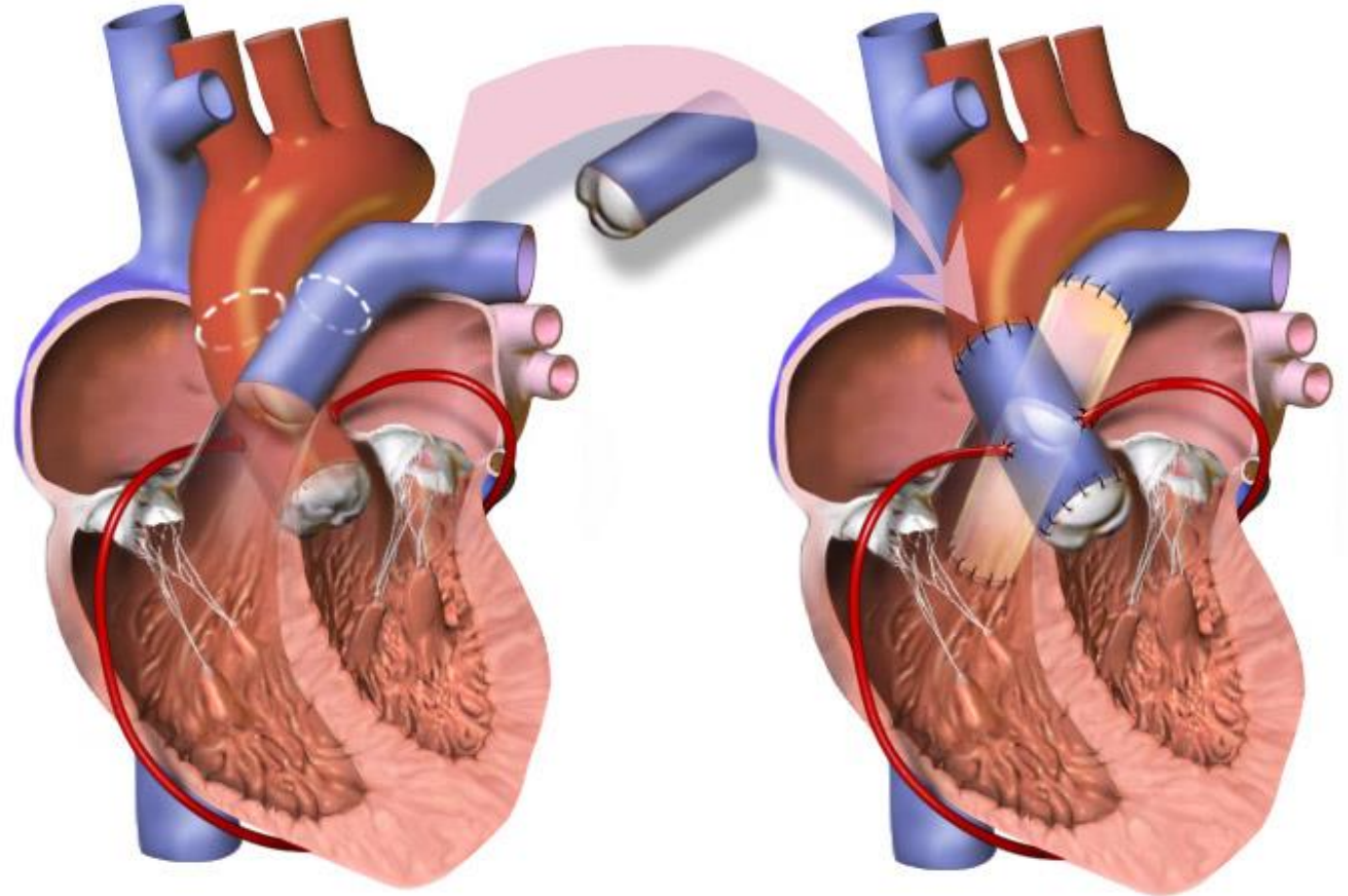
- Homograft used in active infection in the case of endocarditis and root abscess





# ROSS PROCEDURE

- Autograft and homograft



# AORTIC ROOT ENLARGEMENT

Why do a root enlargement?

- Avoid patient prosthesis mismatch
- Allow for valve in valve in the future
- Prevent structural valve deterioration



# TECHNIQUES

Nicks: incision through the non coronary sinus



Manouguins: incision through the commissure between the left and non coronary sinus



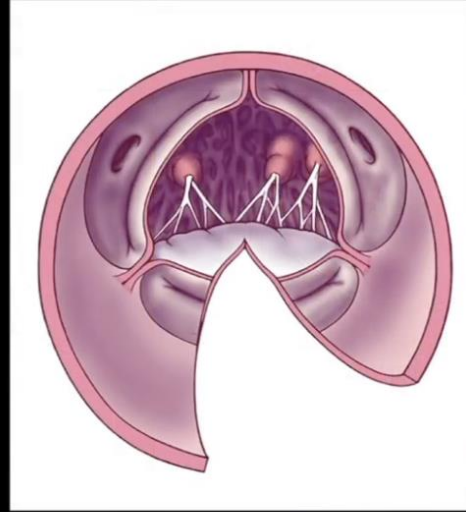
Y incision: allows for 3-4 valve upsize

1

## Root enlargement

Nicks Technique

- The aortotomy is extended through the noncoronary sinus across the aortic annulus

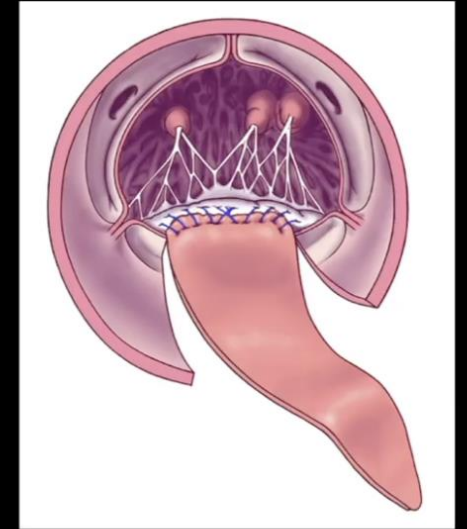


2

## Root enlargement

Nicks Technique

- A pericardial patch is used to reconstruct the aortic defect

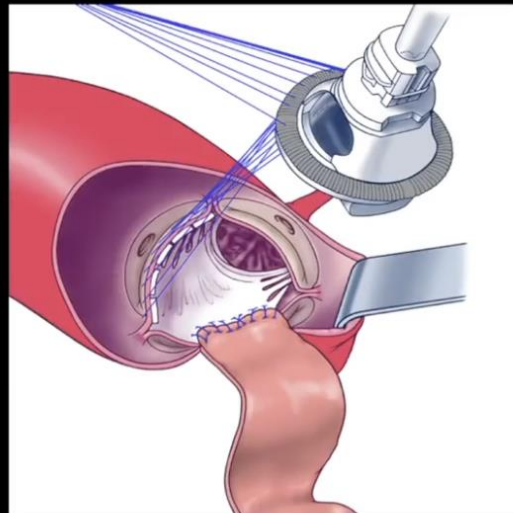


3

## Root enlargement

Nicks Technique

- After sizing the valve, a prosthetic aortic valve is sewn to the aortic annulus

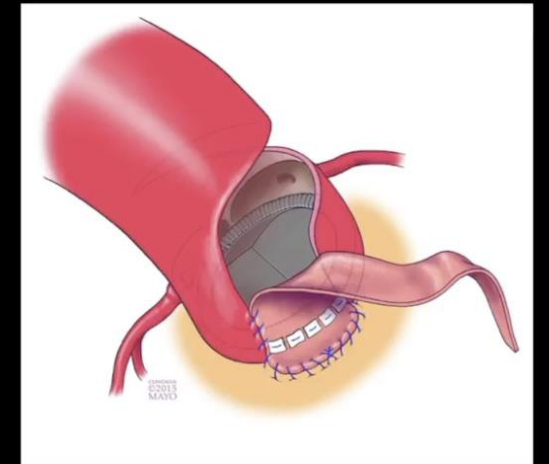


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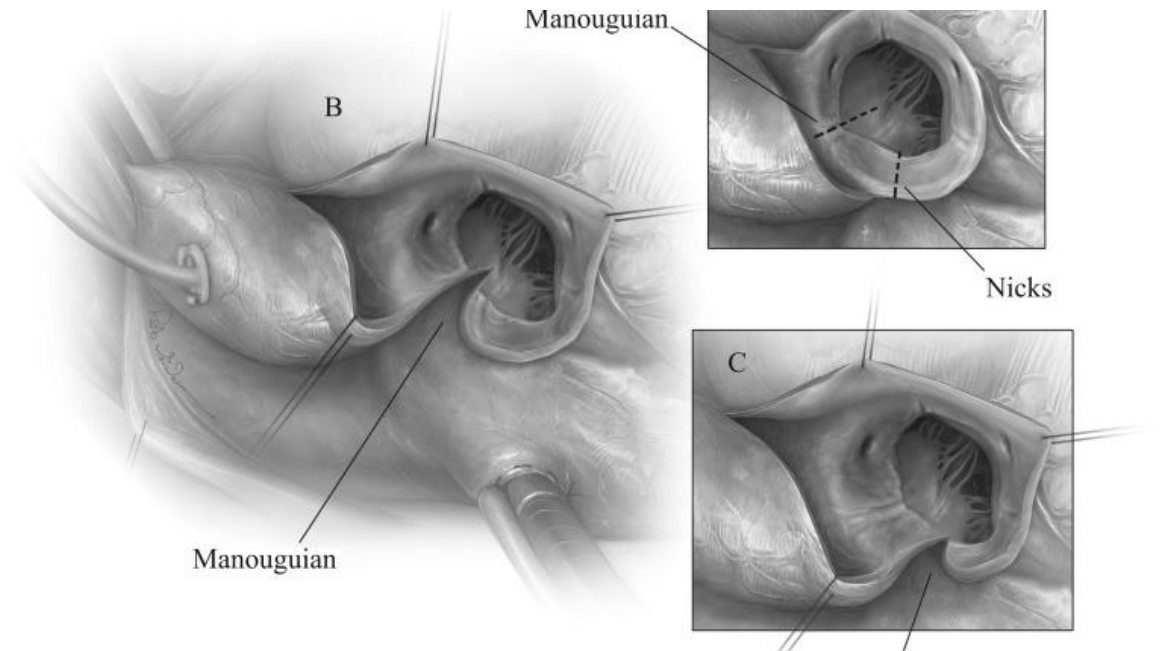
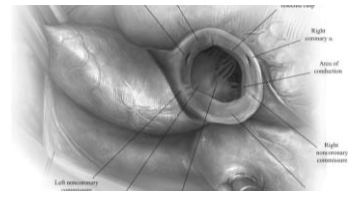
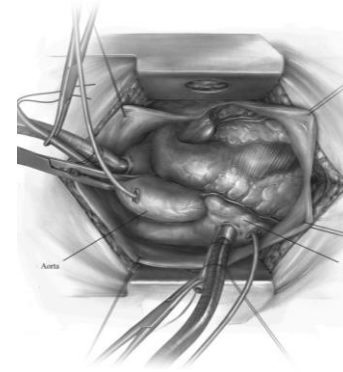
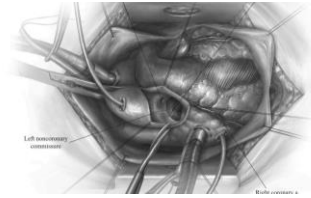
## Root enlargement

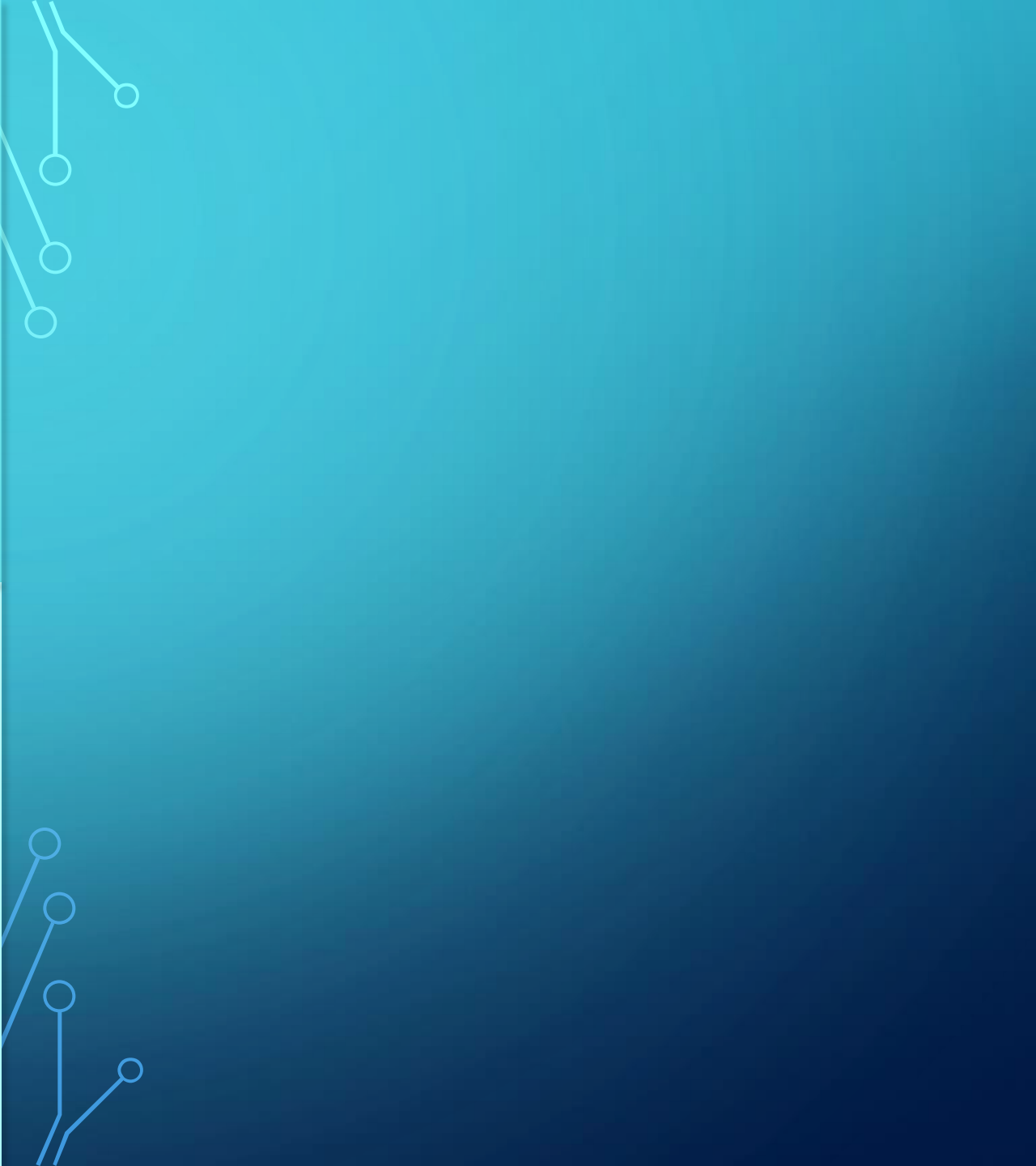
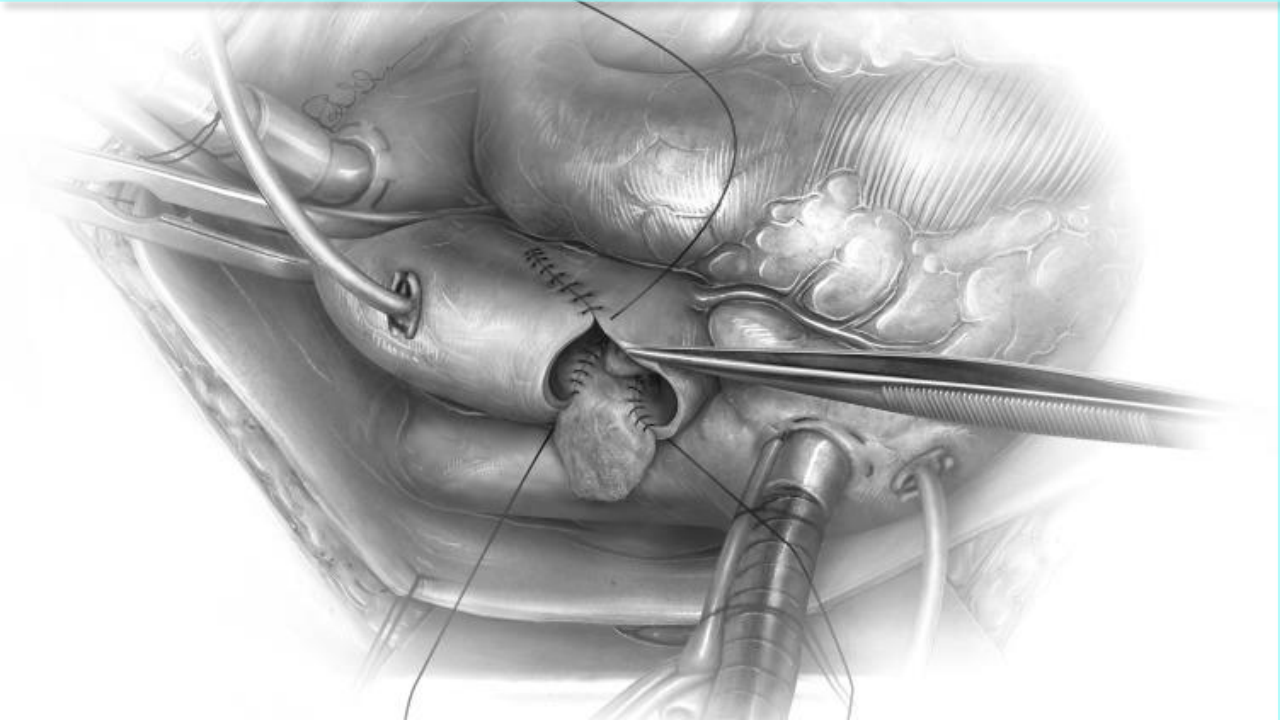
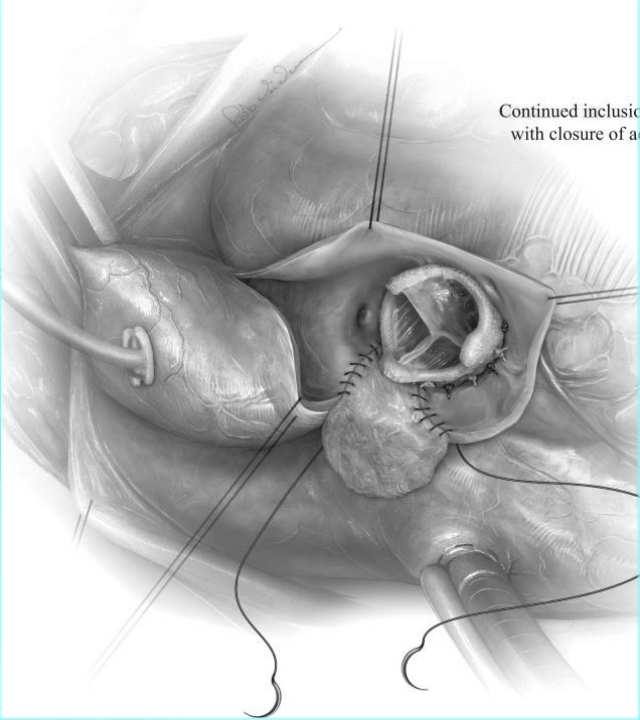
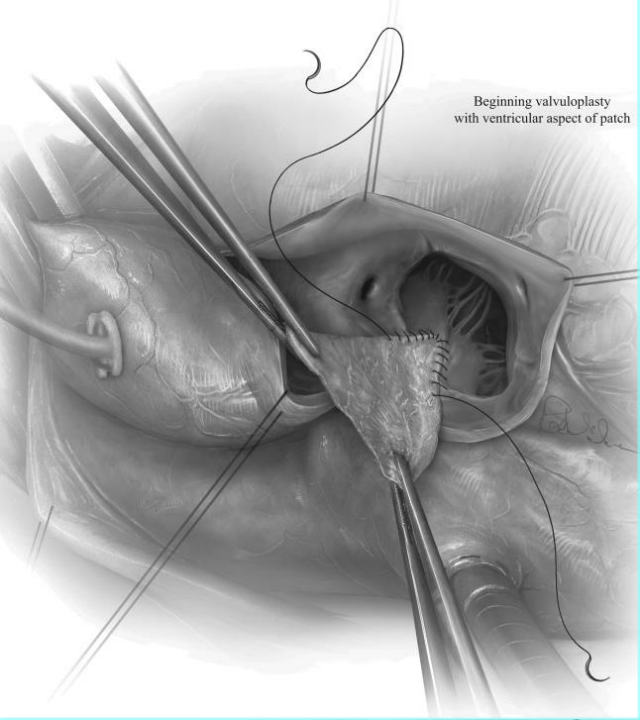
Nicks Technique

- The pericardial patch is trimmed to the size of the defect and a continuous suture is used to close the aortotomy

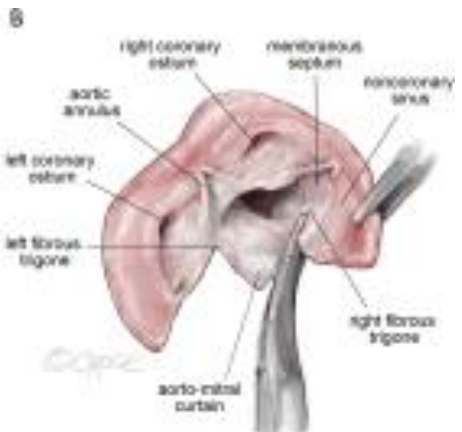
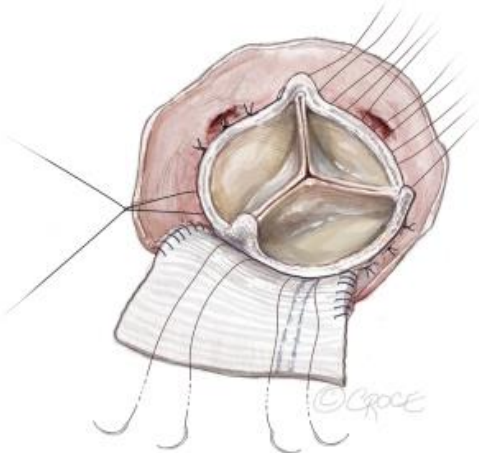








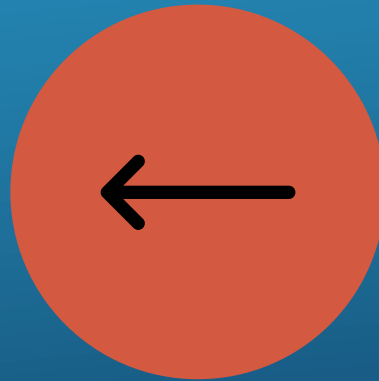
# Y INCISION



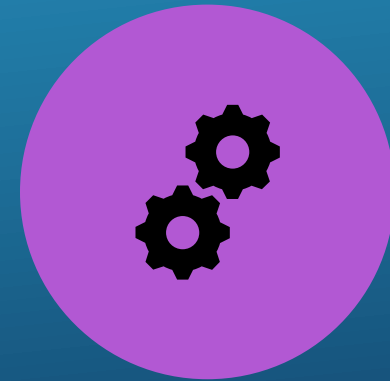
# MINIMALLY INVASIVE APPROACH



MINI STERNOTOMY



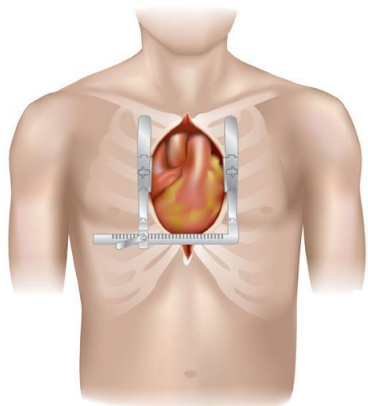
RIGHT  
THORACOTOMY



ROBOTIC  
APPROACH

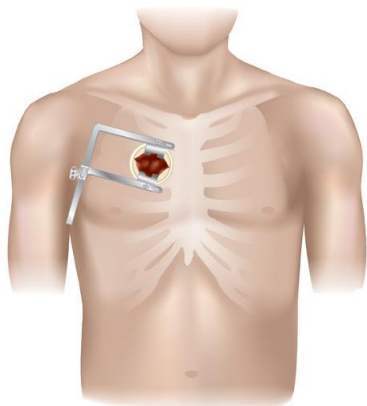


Conventional

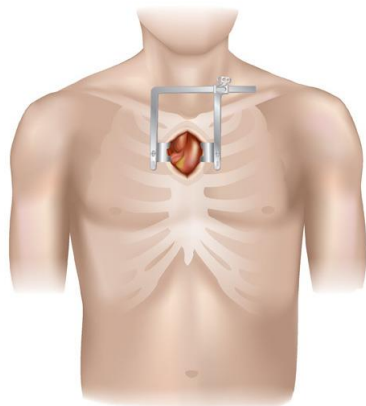


Sternotomy

Minimally-invasive

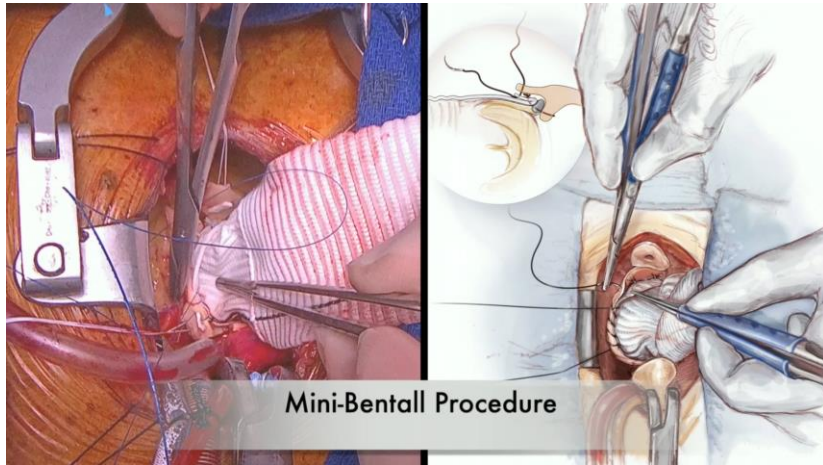
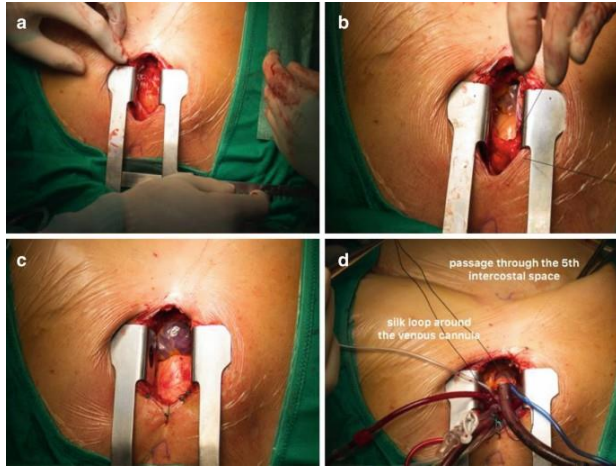


Mini-thoracotomy

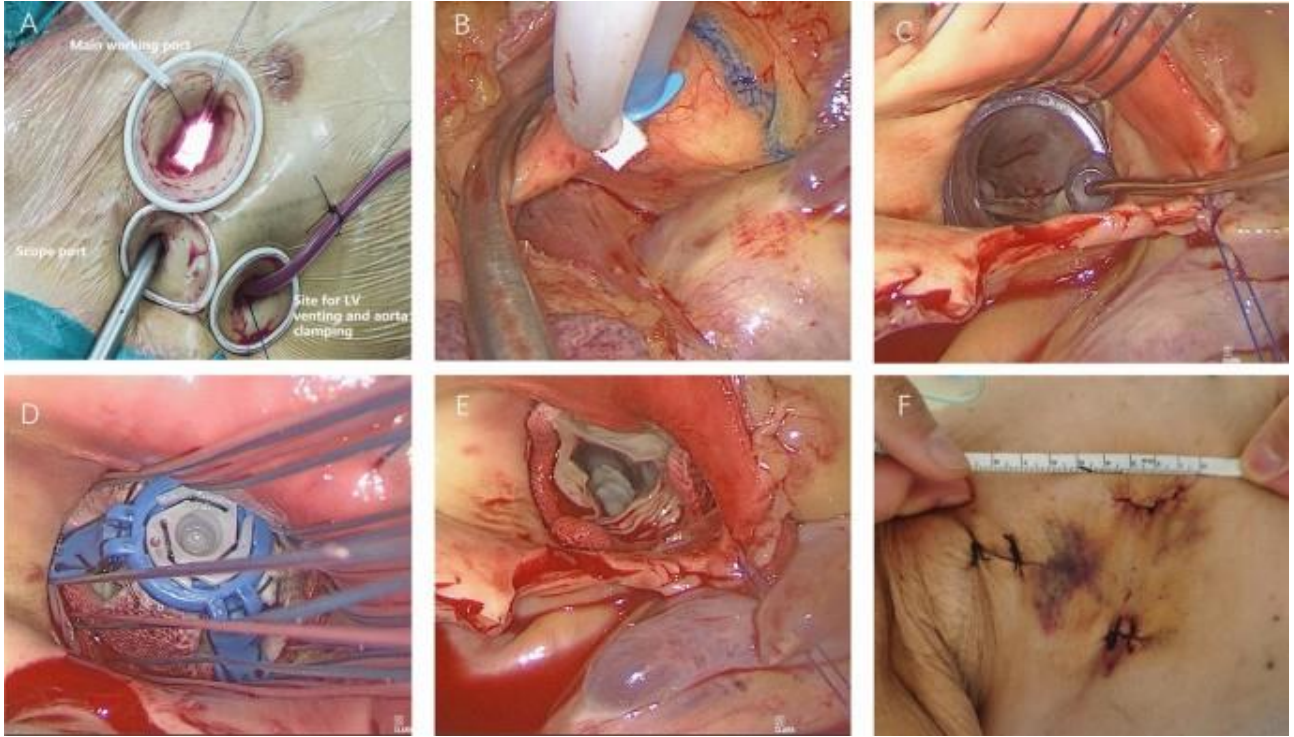


Hemi-sternotomy

# MINI STERNOTOMY



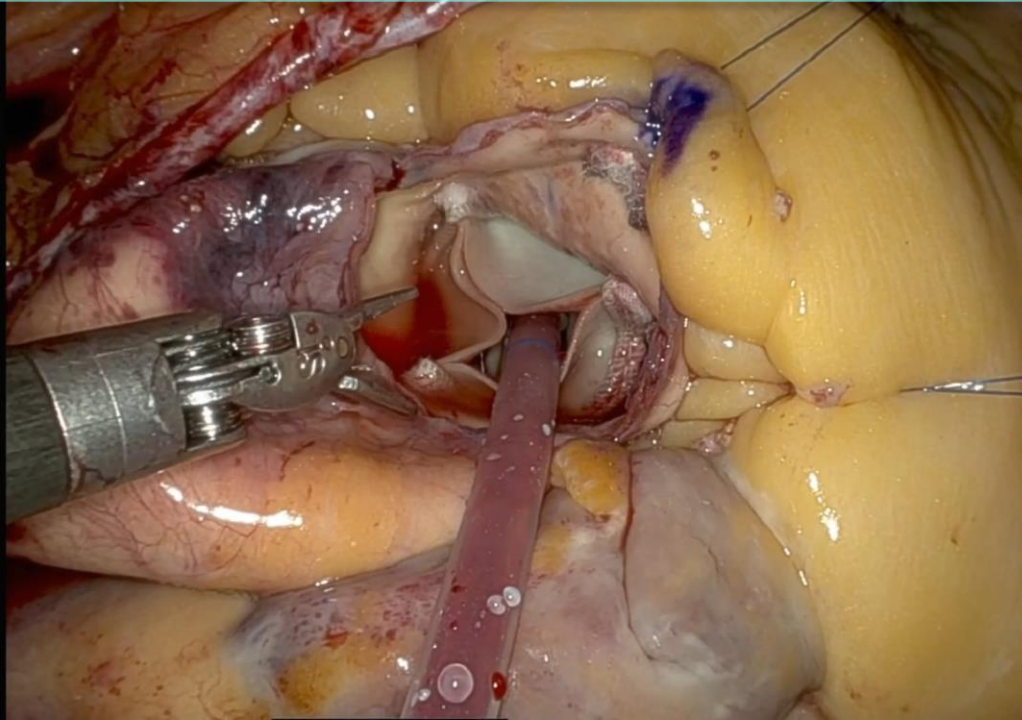
# MINI THORACOTOMY







# ROBOTIC APPROACH



THANK YOU

