Indications and Late Results of Aortic Valve Repair

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Aortic Valve Repair

Question # 1

Can the valve be repaired?

Quesiton # 2

Should the valve be repaired?

Pre-requisites for Valve Repair

- Understanding of Functional Anatomy and Pathophysiology
- Quality of Tissue
- Reproducible Surgical Techniques
- Durable Outcome

Pathophysiology of AI:
What do we know?

Causes of Pure Aortic Regurgitation in Patients Having Isolated Aortic Valve Replacement at a Single US Tertiary Hospital (1993 to 2005)

William Clifford Roberts, MD; Jong Mi Ko, BA;
Timothy Richard Moore, MD; William Hampton Jones III, MD

Background—The causes of aortic regurgitation (AR) severe enough to warrant aortic valve replacement (AVR) have received little attention in the last 20 years.

Methods and Results—We analyzed the causes of pure AR in 268 patients >20 years of age having isolated AVR at Baylor University Medical Center from 1993 to 2005 that was unassociated with mitral stenosis, mitral valve replacement, or a previous operation involving a cardiac valve or ascending aorta. In 122 patients (46%), the AR resulted from a problem with the aortic valve: congenital malformation unassociated with infective endocarditis, 66 patients (54%); infective endocarditis, 46 patients (38%; 15 with bicuspid valves); probable rheumatic heart

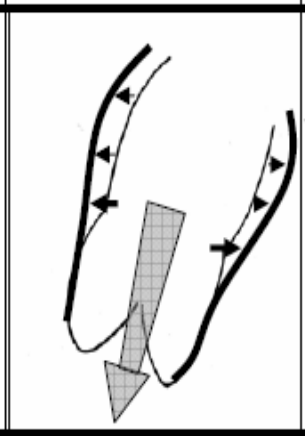
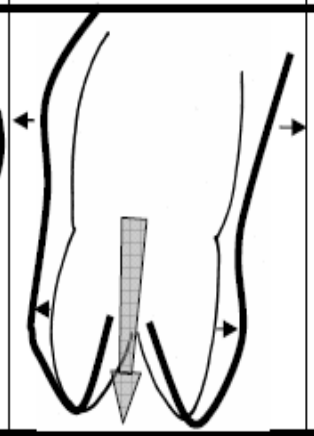
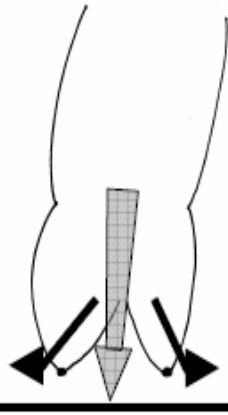
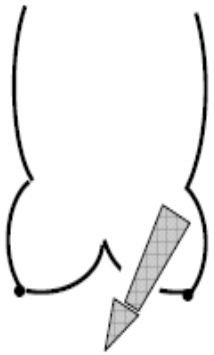
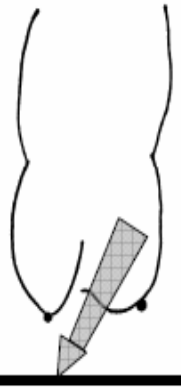
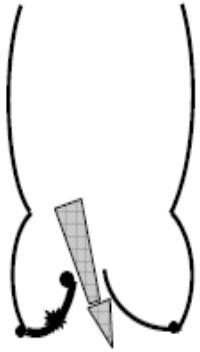
<u>Conclusion:</u> The causes of pure AR severe enough to warrant isolated AVR are diverse. The most common category in this study was cause "unclear"

Key Words: bypass ■ calcium ■ coronary disease ■ hypertension ■ regurgitation

Classification of Aortic Insufficiency

- Apply to all anatomic subtypes of AI
- Clarify and provide insight into mechanism
- Provide a standard communication tool between cardiologists, surgeons, anesthesiologists
- Guide the potential surgical treatment
- Assess the long-term efficacy of different types of surgical repair

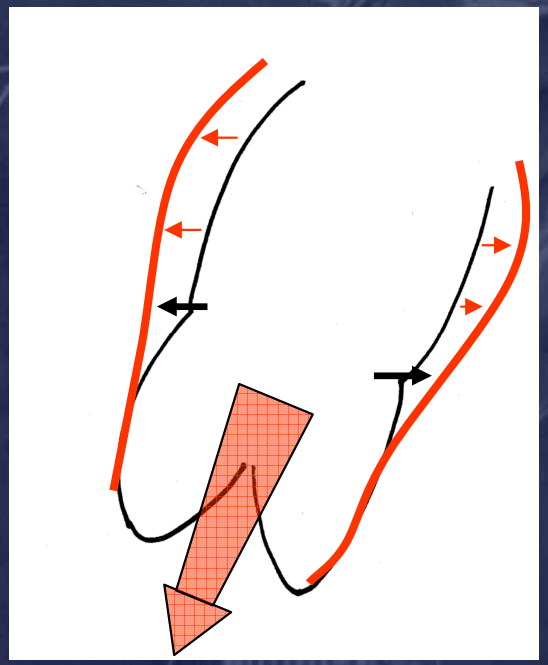
The Functional Aortic Annulus

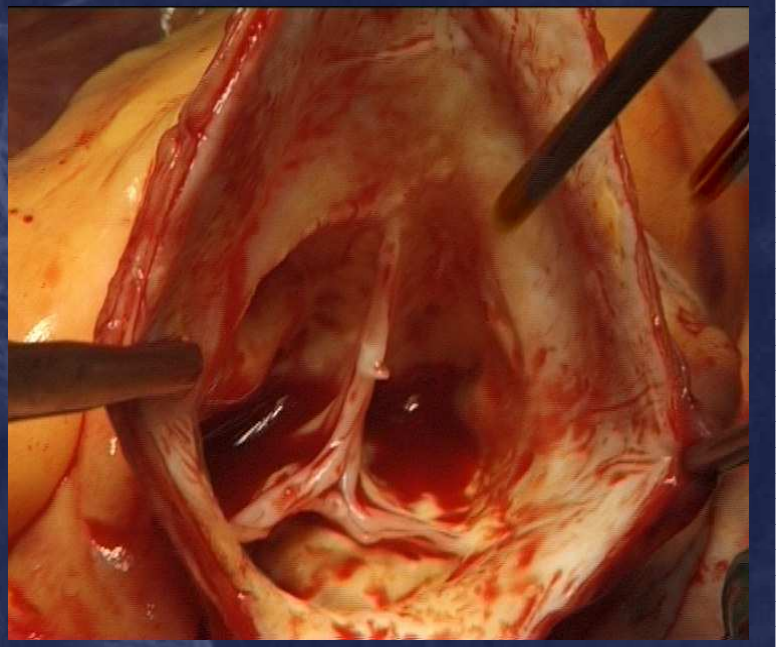
AI Class	Type I Normal cusp motion with FAA dilatation or cusp perforation				Type II Cusp Prolapse	Type III Cusp Restriction
	Ia	Ib	Ic	Id		
Mechanism						
Repair Techniques (Primary)	STJ remodeling *Ascending aortic graft*	Aortic Valve sparing: *Reimplantation or Remodeling with SCA*	SCA	Patch Repair *Autologous or bovine pericardium*	Prolapse Repair *Plication* *Triangular resection* *Free margin Resuspension* *Patch*	Leaflet Repair *Shaving* *Decalcification* *Patch*
(Secondary)	SCA		STJ Annuloplasty	SCA	SCA	SCA

STJ – Sino-tubular Junction; SCA – Sub-Commissural Annuloplasty

A Functional Approach to Aortic Insufficiency

Dysfunction	Lesions
Type I : normal cusp motion	• Ia : sino-tubular junction dilatation • Ib : STJ + sinuses dilatation • Ic : annular dilatation • Id : cuspal defect





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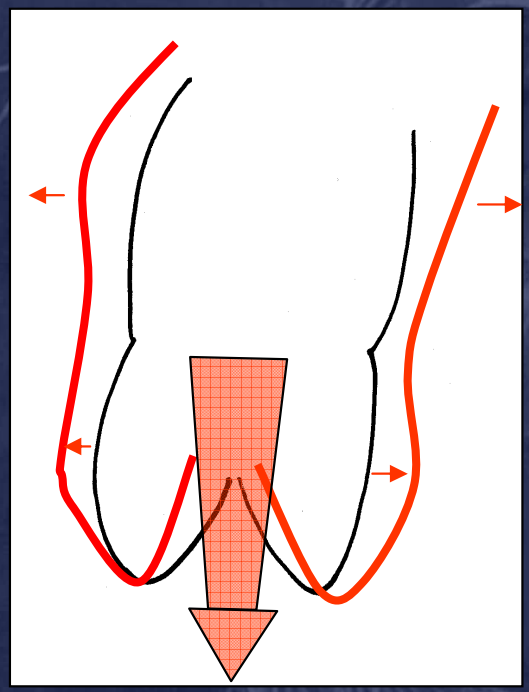

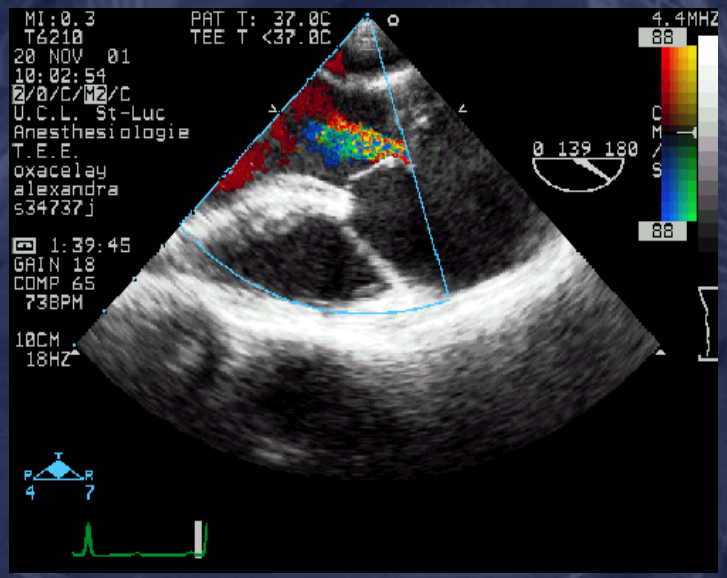

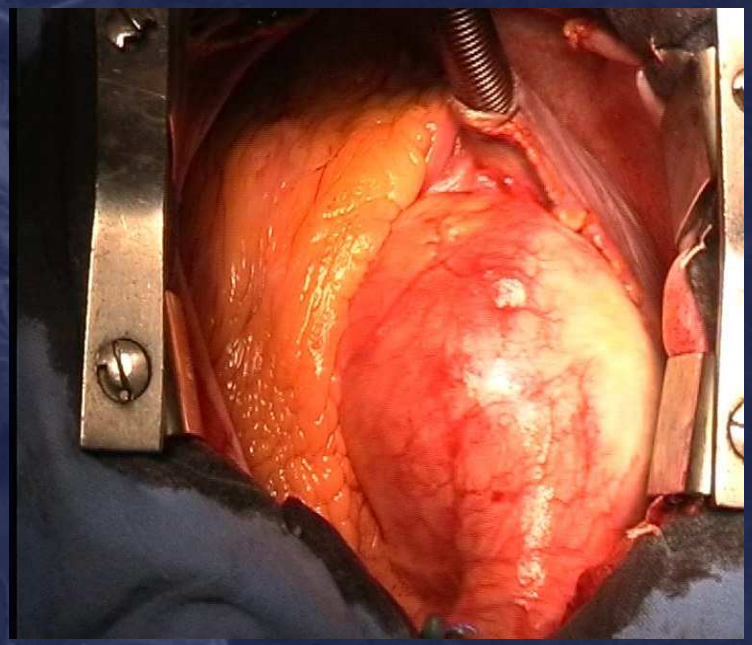

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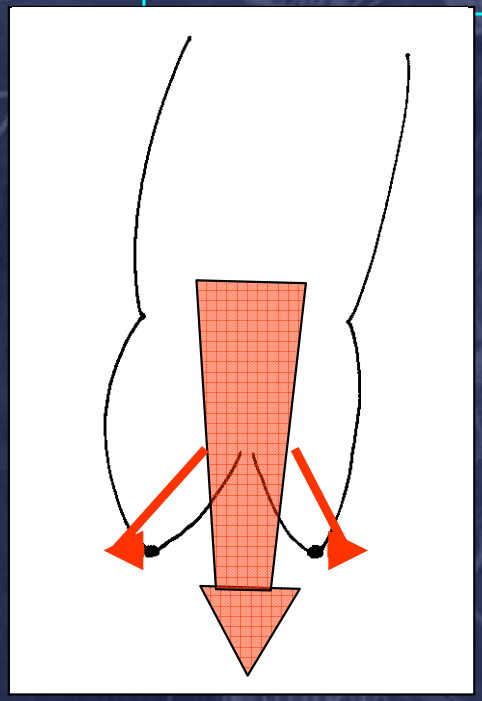

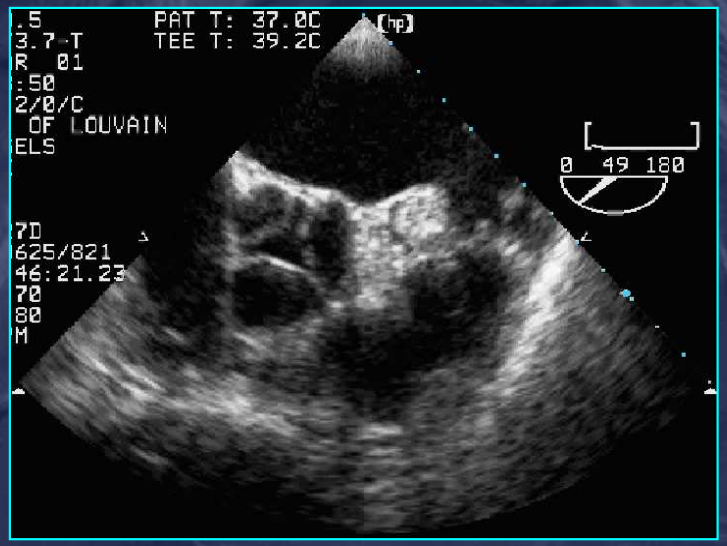

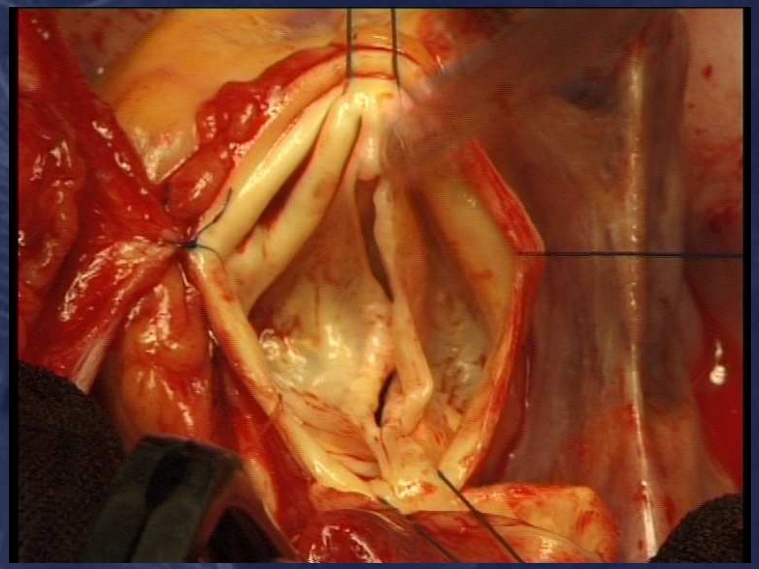

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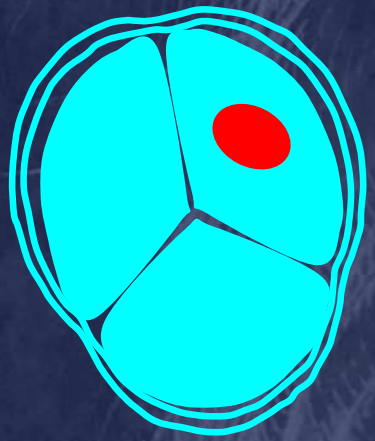
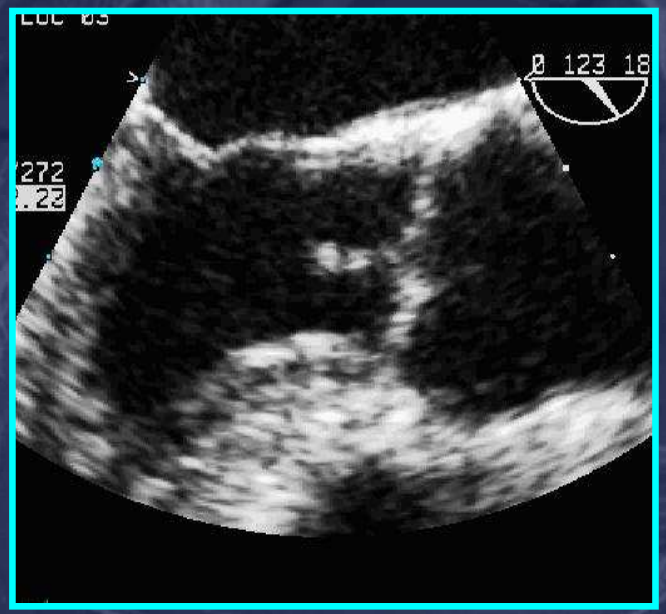
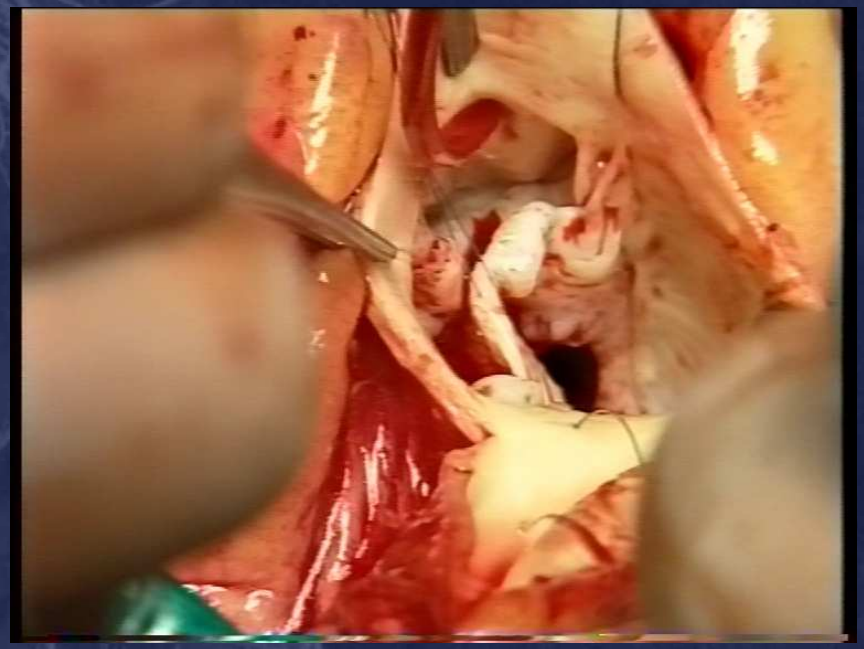
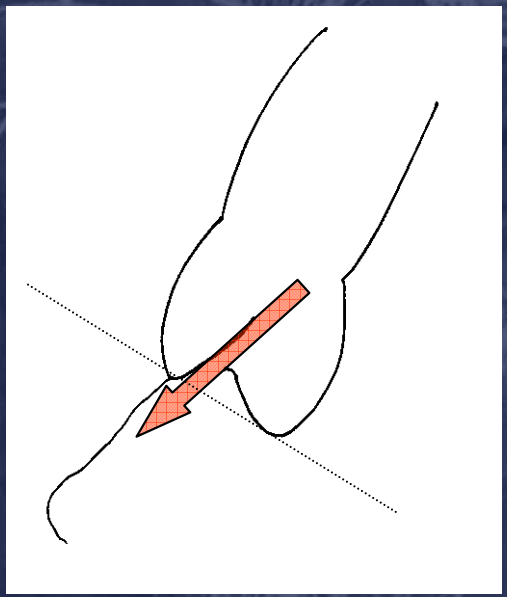


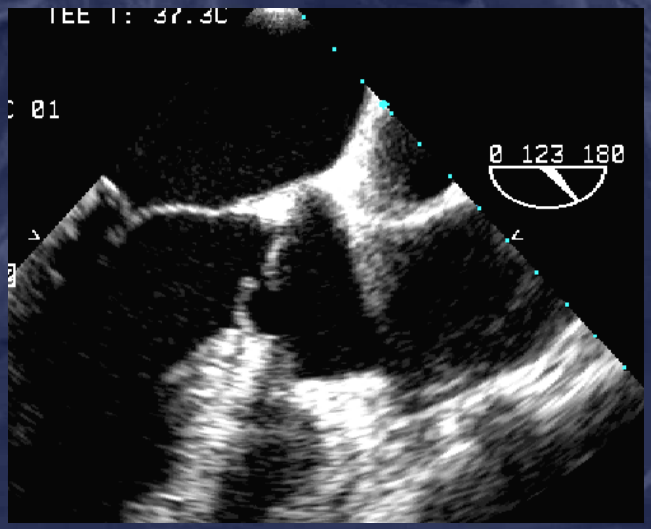


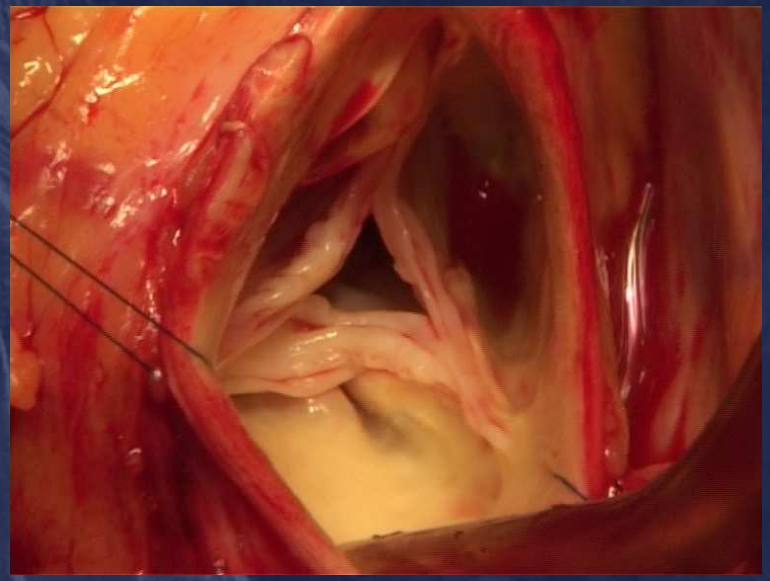


A Functional Approach to Aortic Insufficiency

Dysfunction	Lesions
Type II : excess cusp motion	• Excess cuspal tissue • Commisural disruption

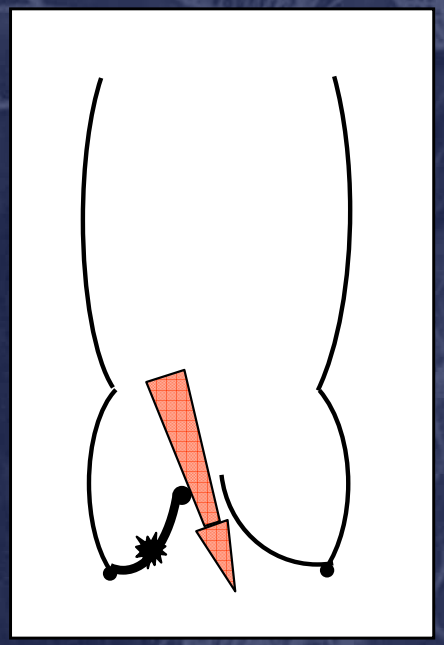


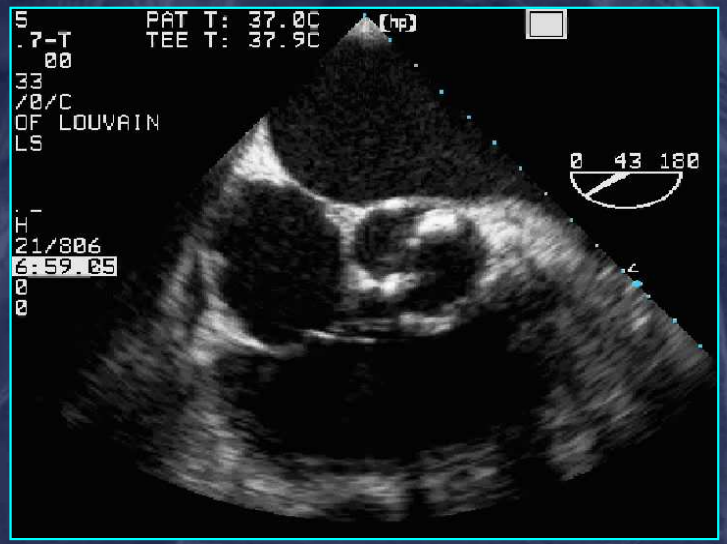




A Functional Approach to Aortic Insufficiency

Dysfunction	Lesions
Type III : restricted cusp motion	• Fibrous thickening • Calcification





Assessment of Tissue Quality

Aortic Valve Pathology

- ***<u>Pure aortic regurgitation</u>***

  - Aortic aneurysm

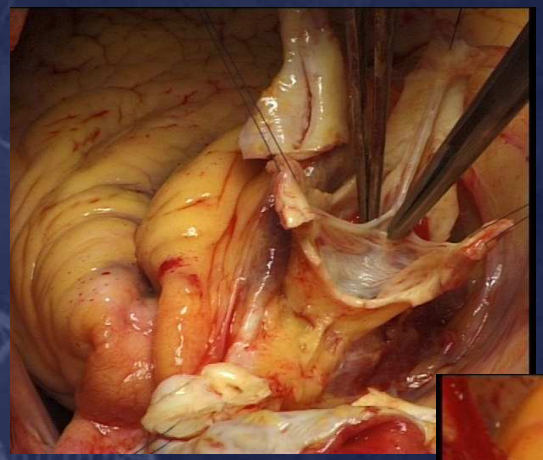
  - Bicuspid aortic valve

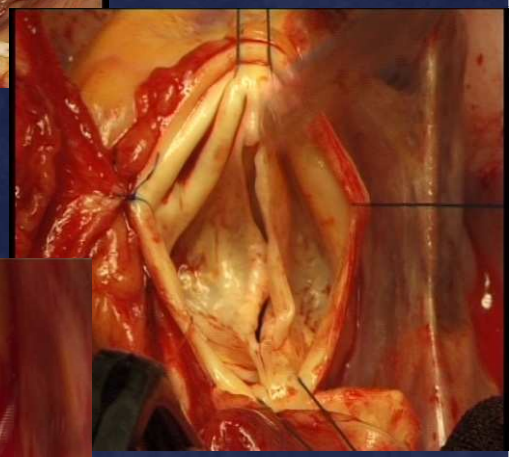
  - Degenerative leaflet prolapse

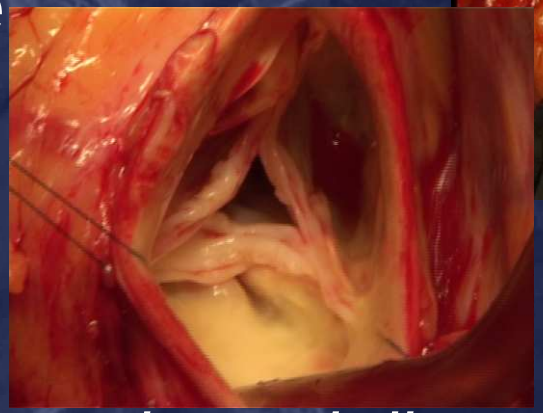
  - *endocarditis*

  - *autograft failure*

  - *acute aortic dissection and commissural disruption*



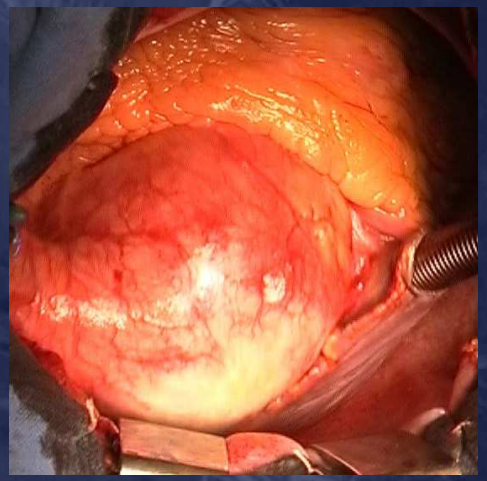


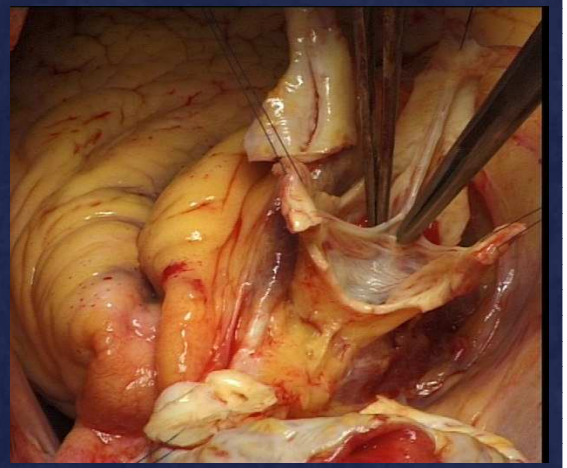


Patient Selection: Pathology

Pure Aortic Regurgitation:

- *Aortic aneurysm*
- *Bicuspid aortic valve*
- *Degenerative leaflet prolapse*
- *Autograft failure*
- *Endocarditis*
- *Acute aortic dissection and commissural disruption*





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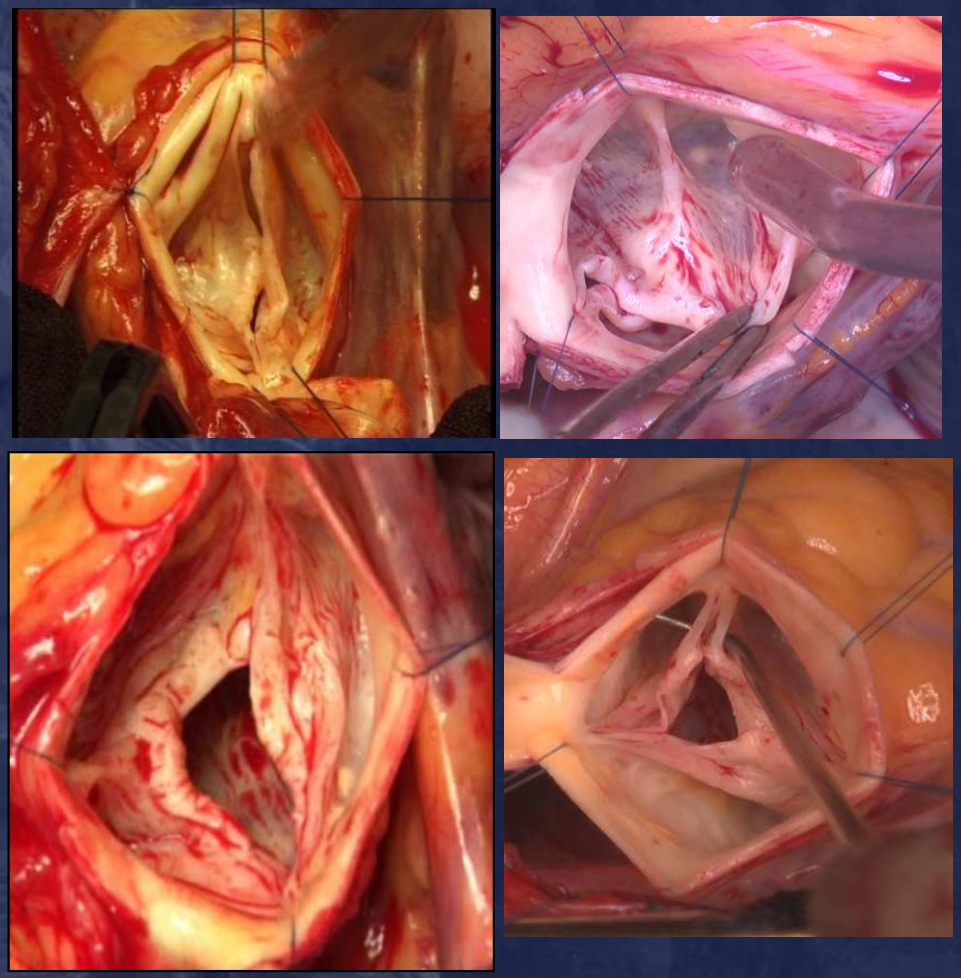

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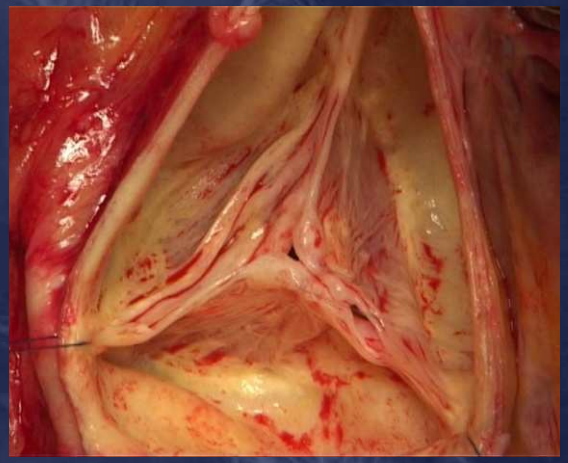

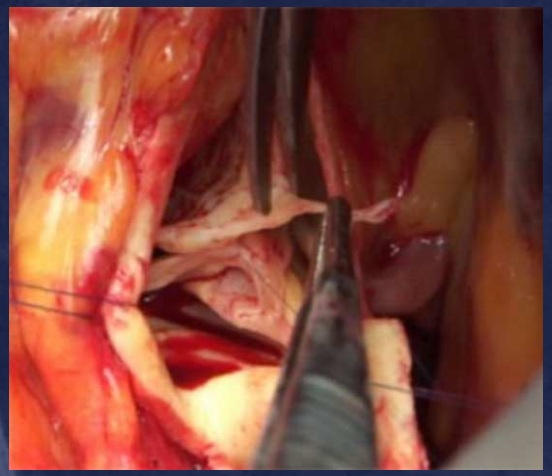

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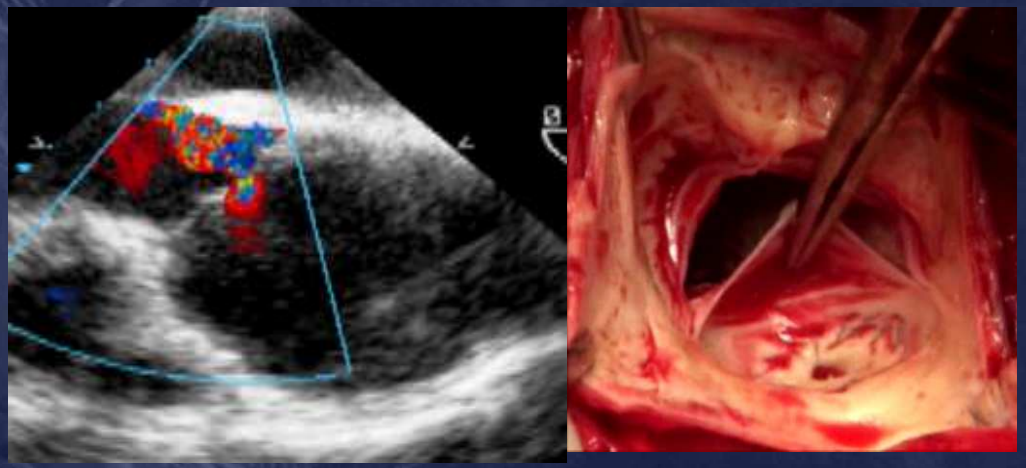

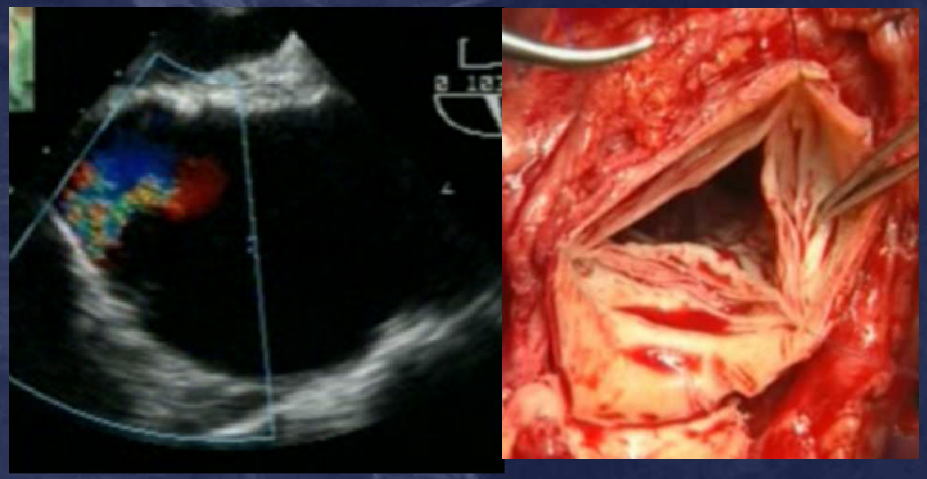

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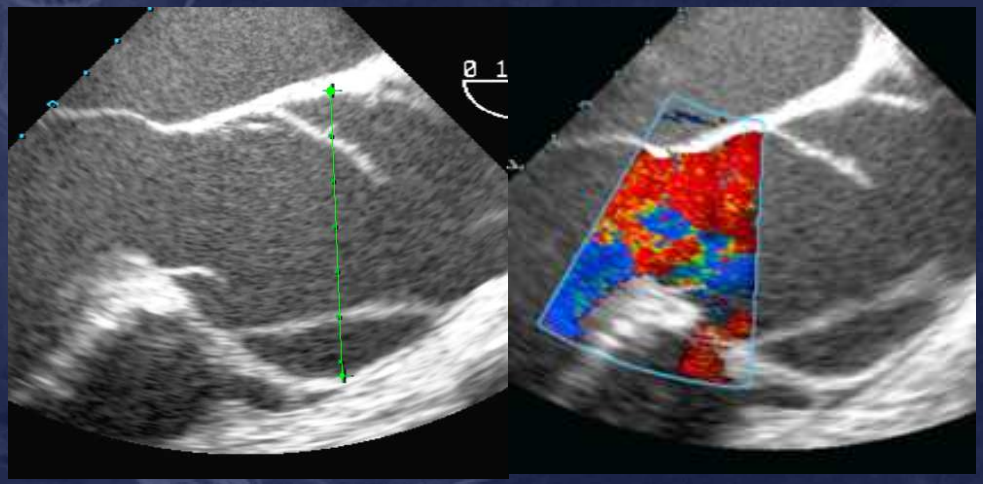
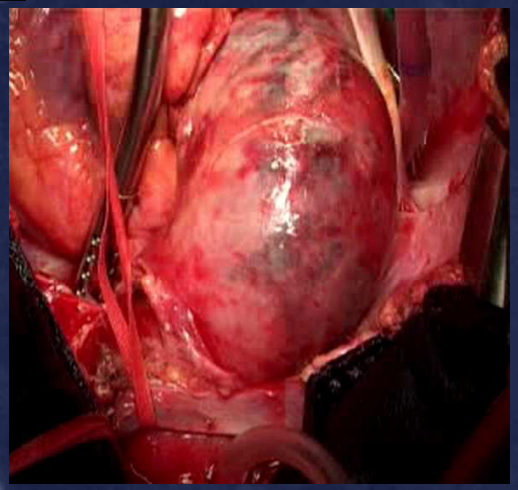


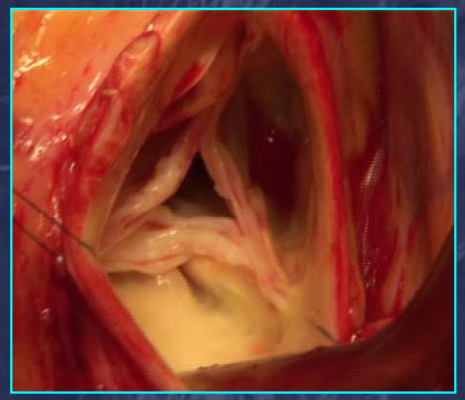
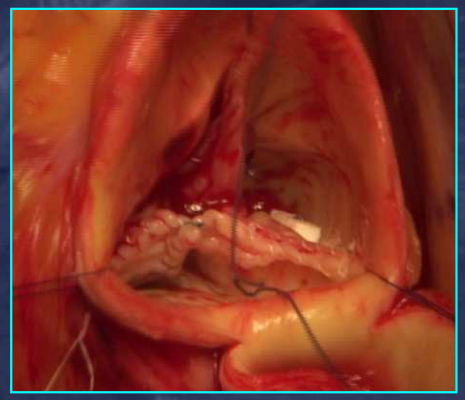
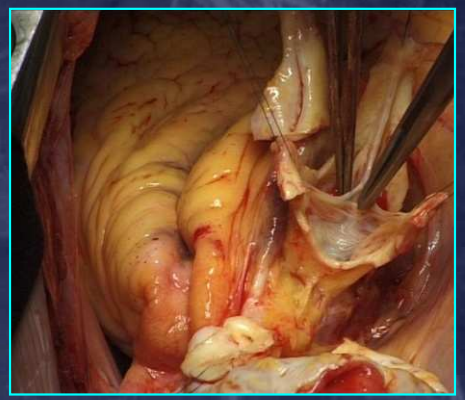
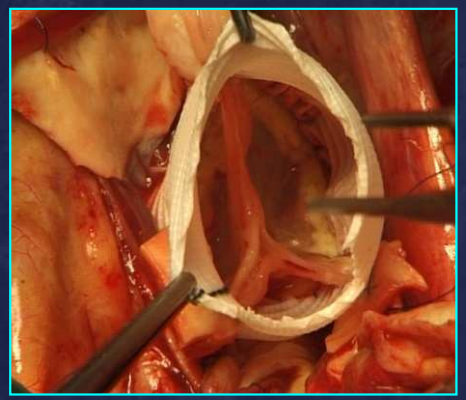


Reproducible Surgical Techniques

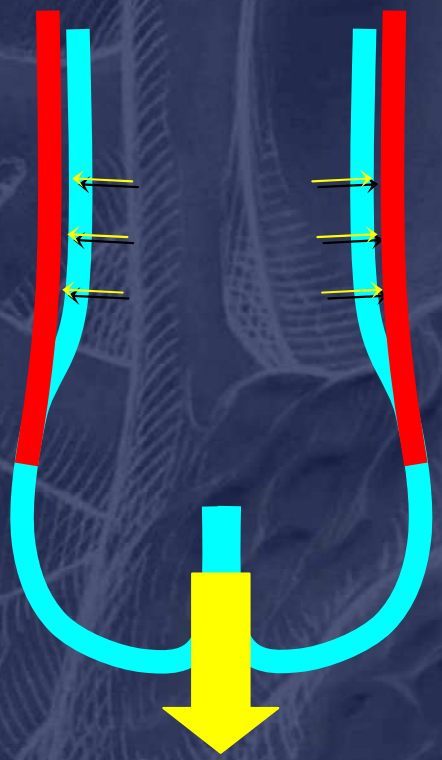
Principles of aortic repair

The goal of aortic repair is to restore a normal surface of coaptation

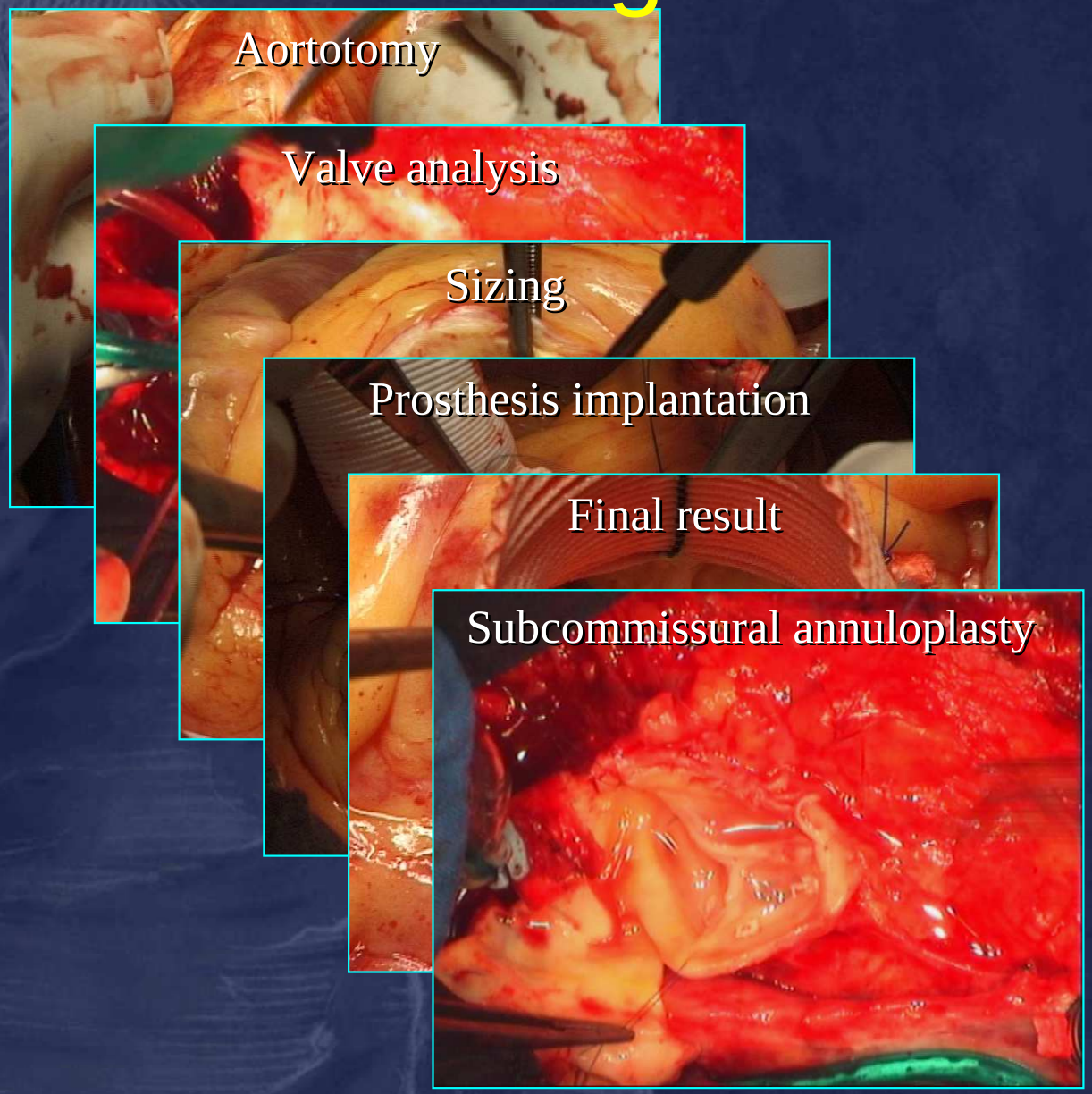
1. Repair or preserve the cuspal tissue
2. Restore the proximal and distal borders of the native stent

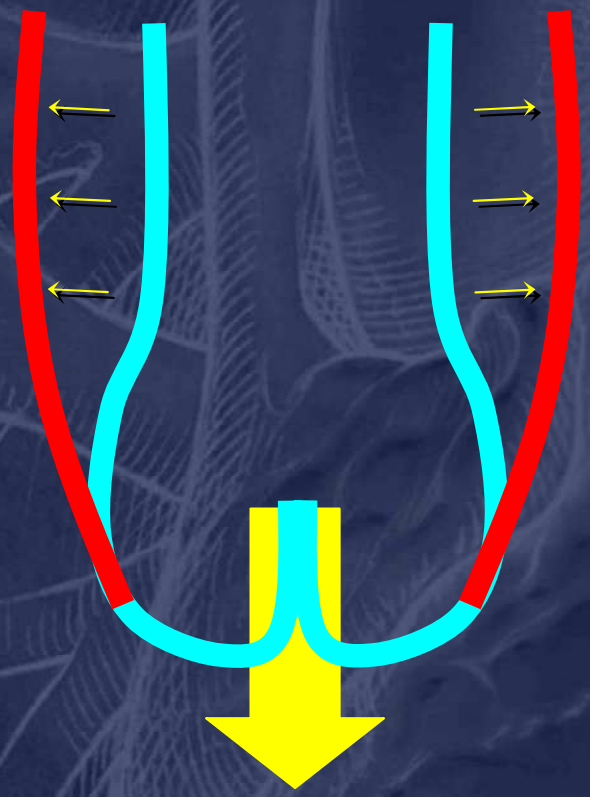
Type Ia repair : Sino-tubular junction remodeling



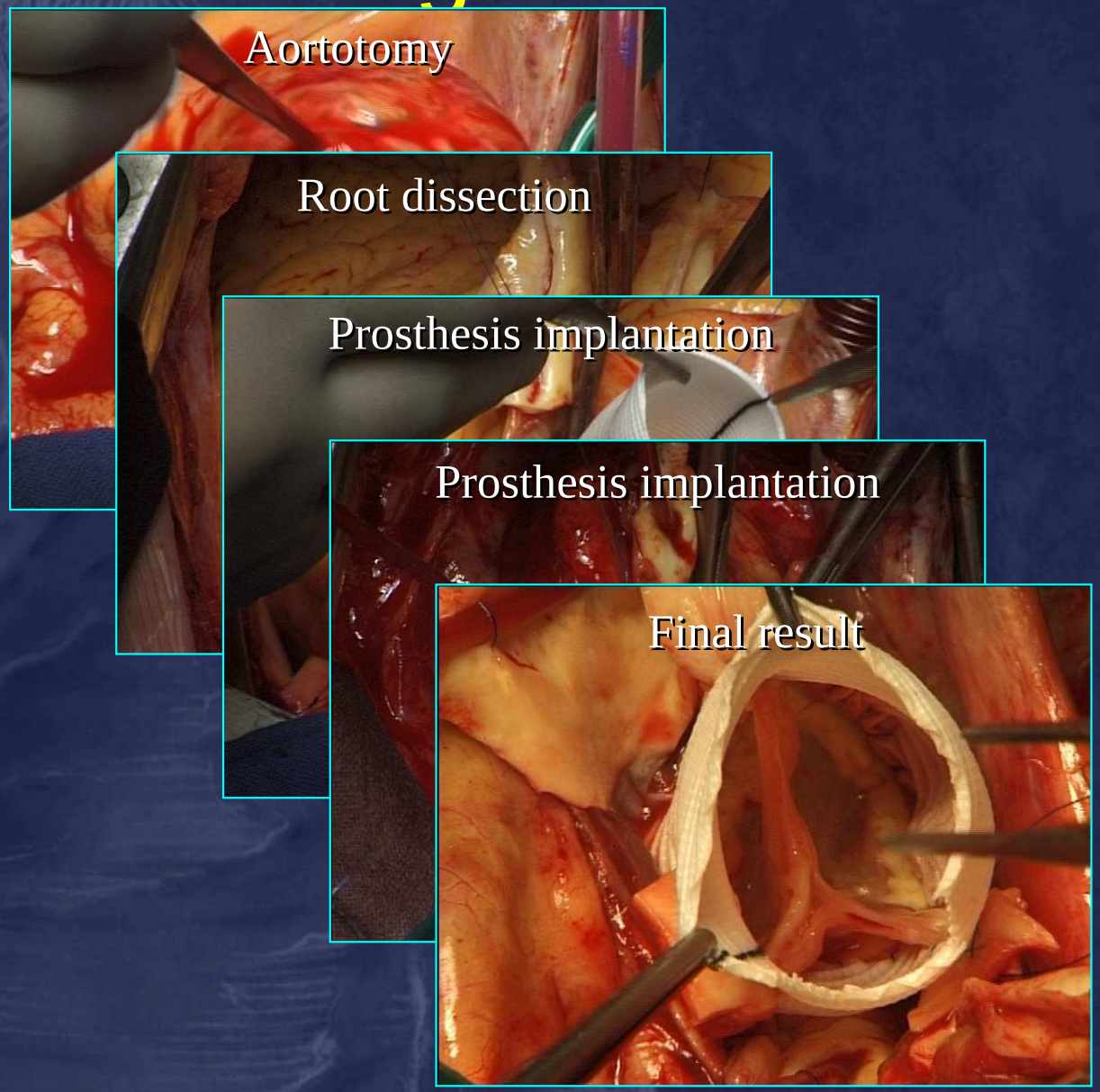
Sino-tubular junction dilatation



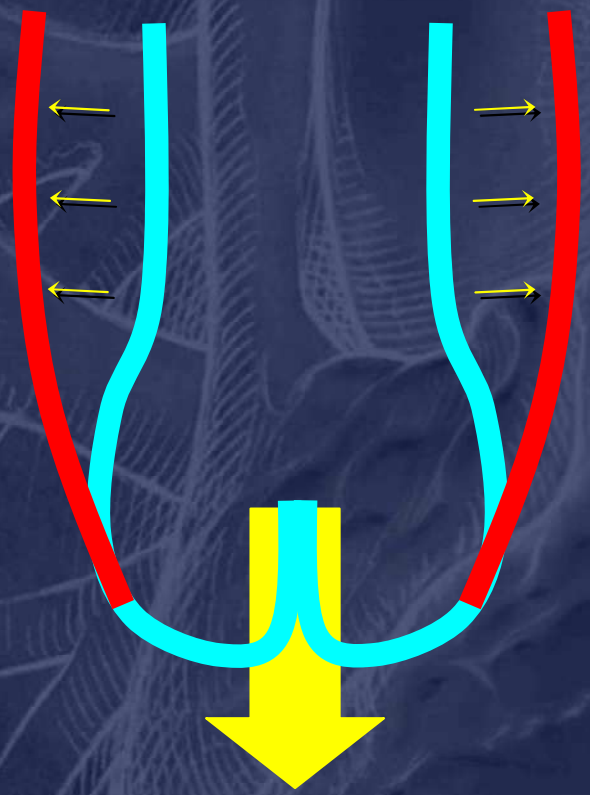
Type Ib repair : Aortic root remodeling



Aortic root aneurysm



Type Ib repair : Aortic root reimplantation



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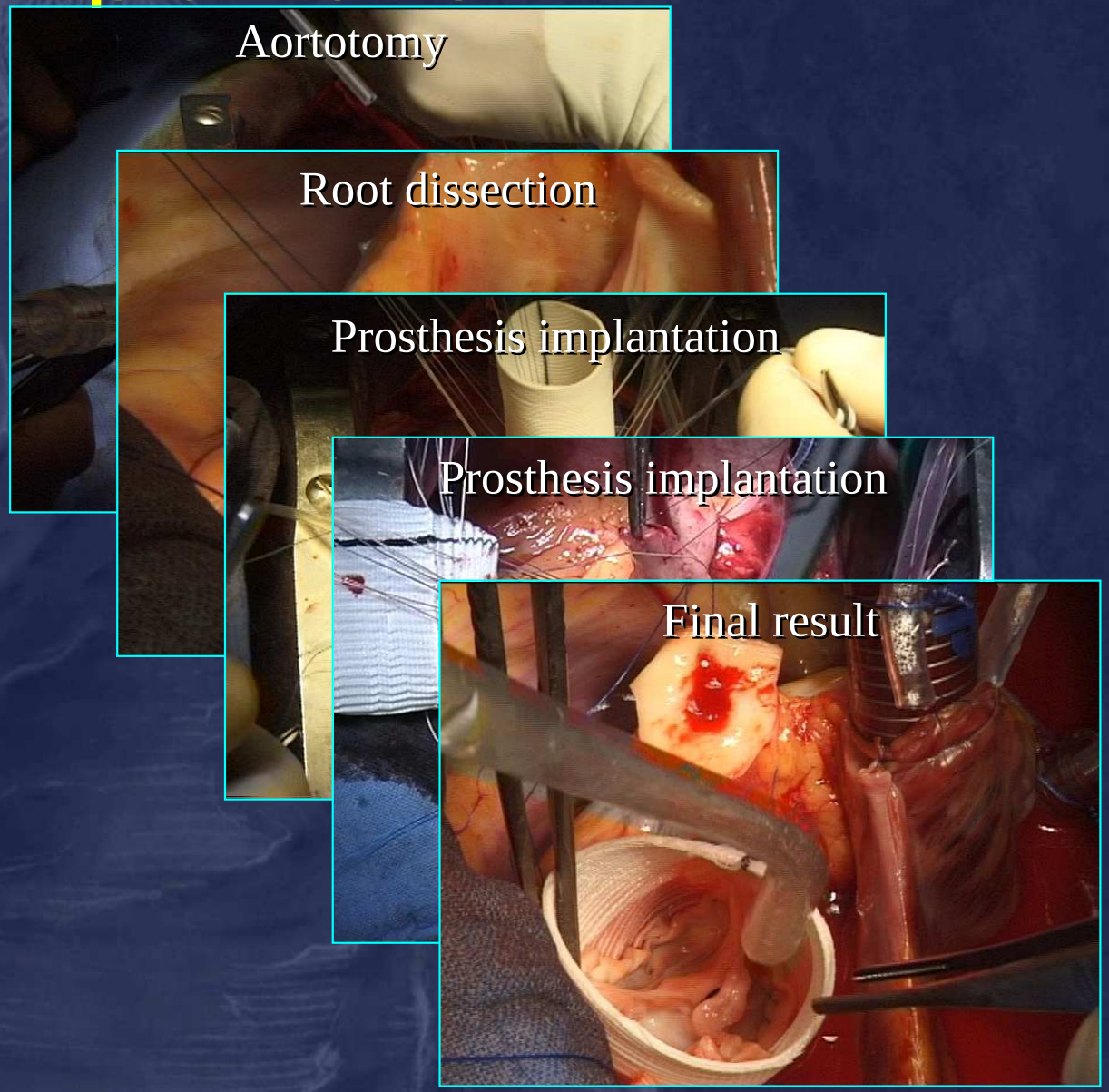
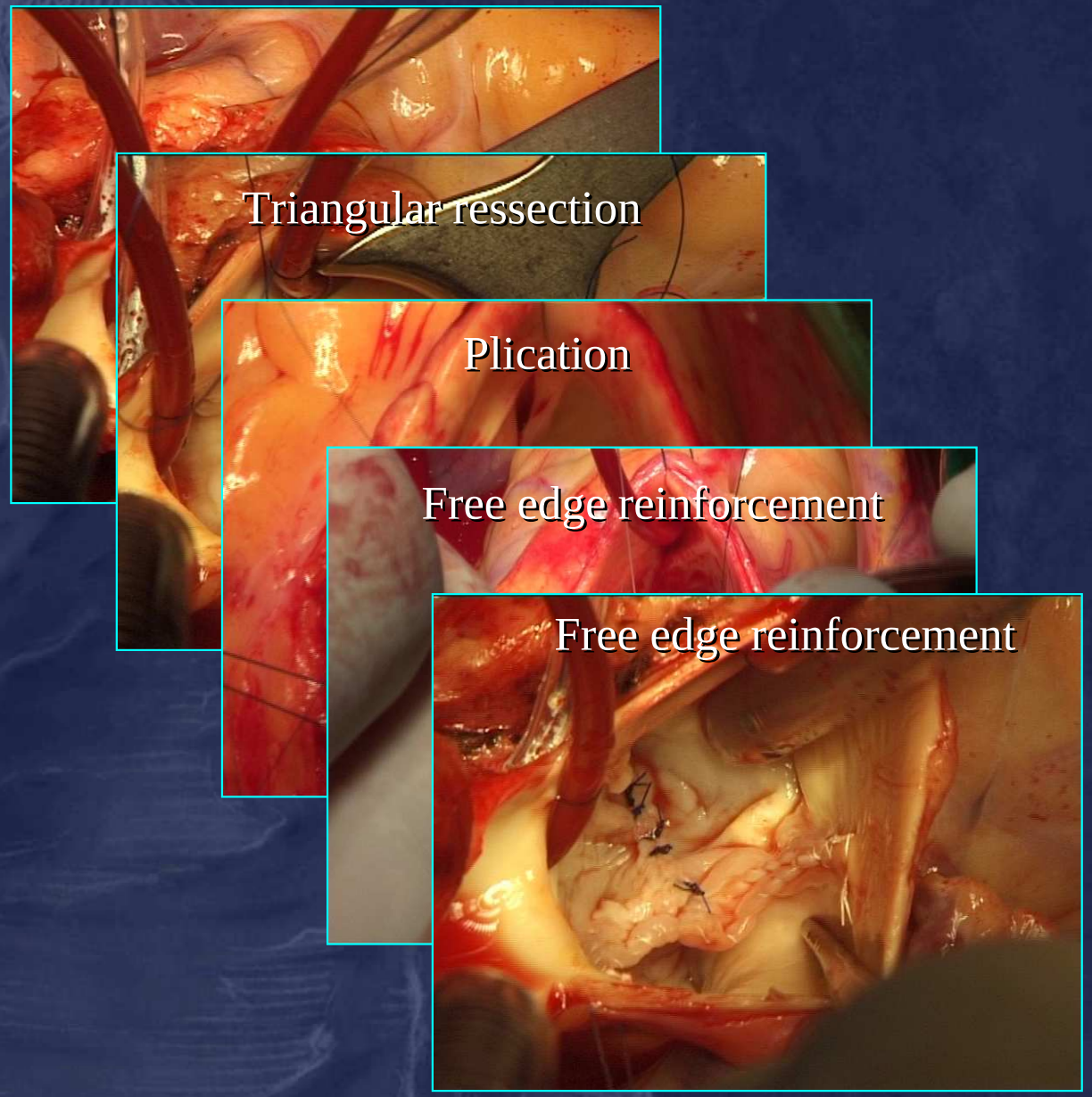
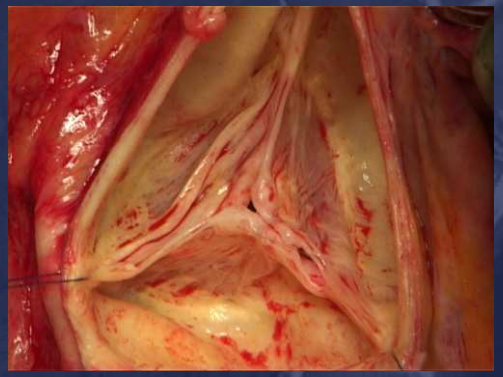


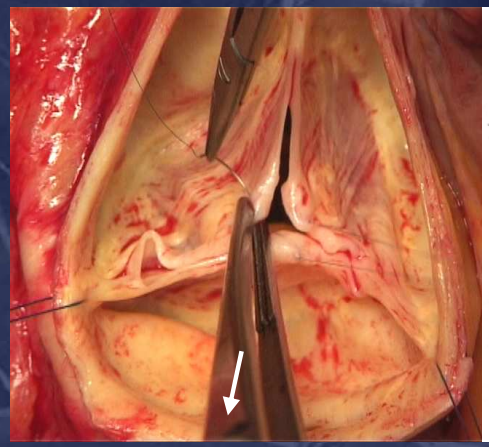
Type II repair

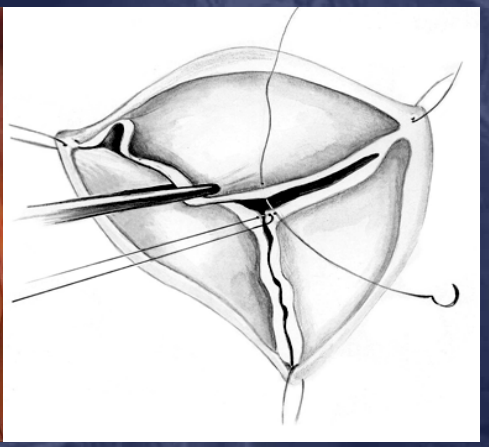
Cuspal prolapse

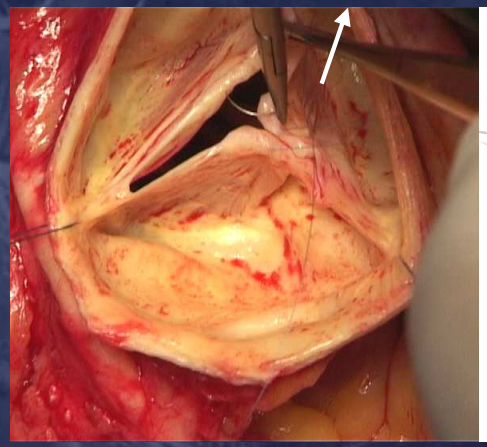


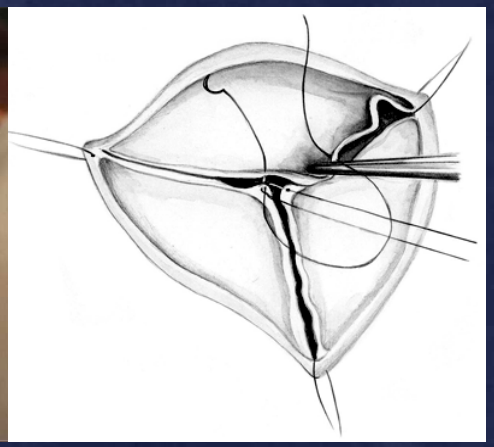


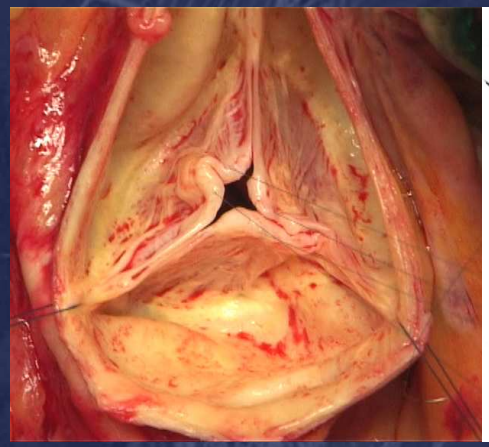
Free Margin Plication

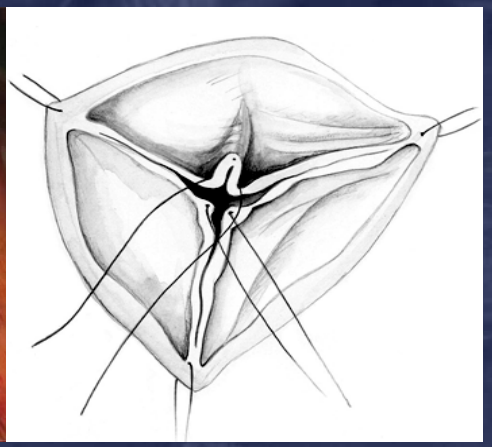


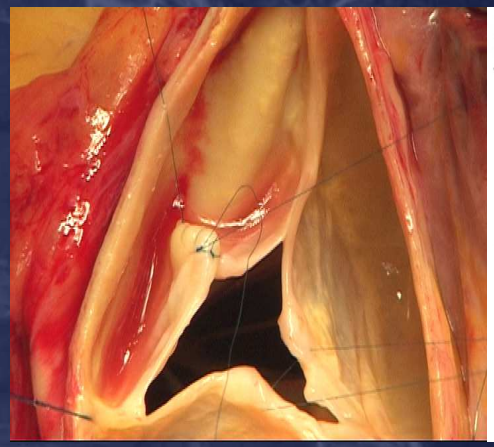


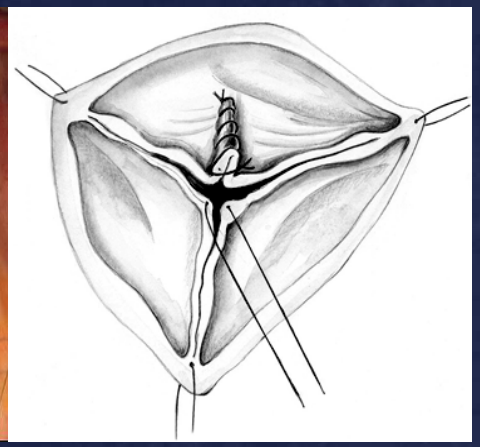






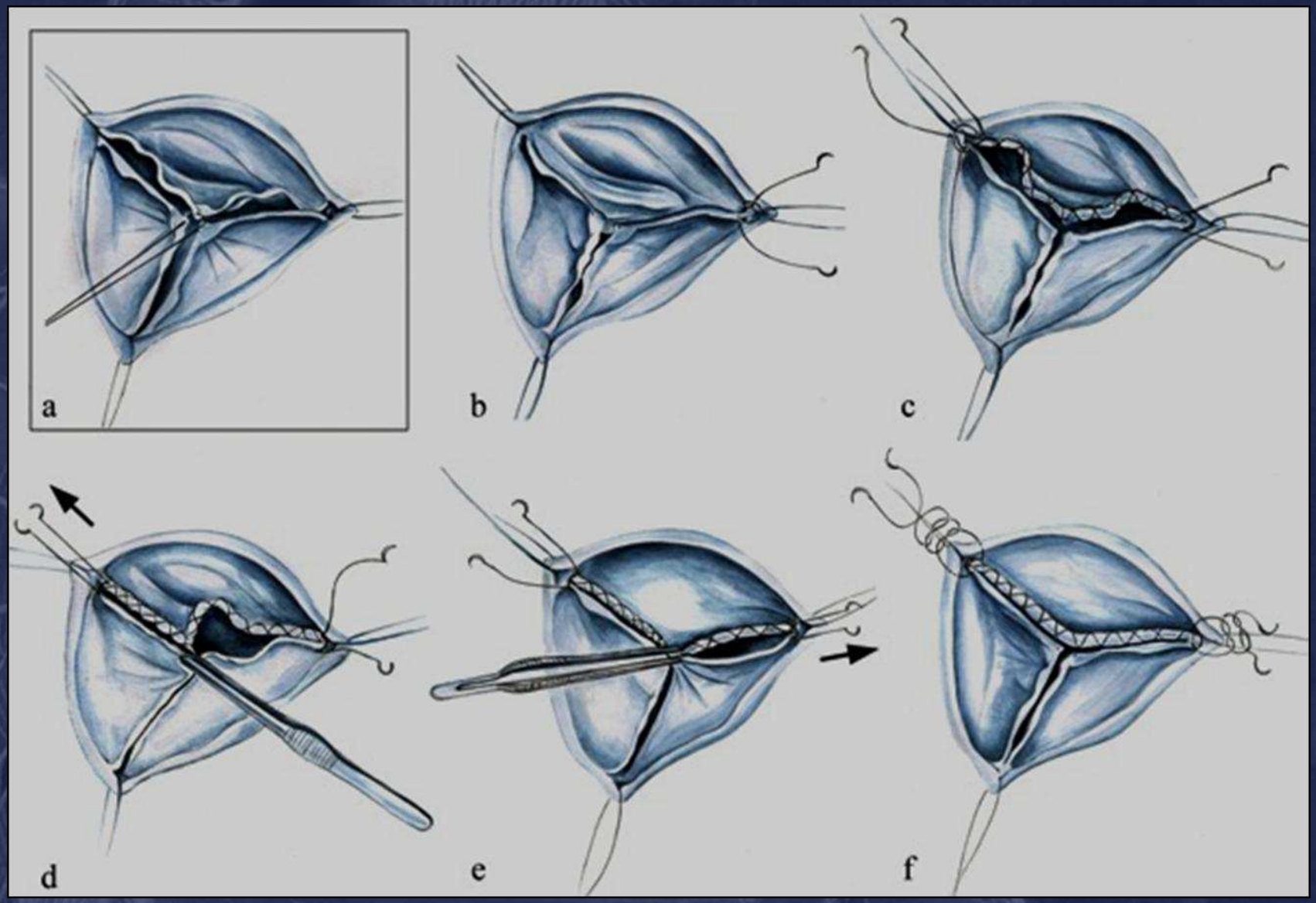




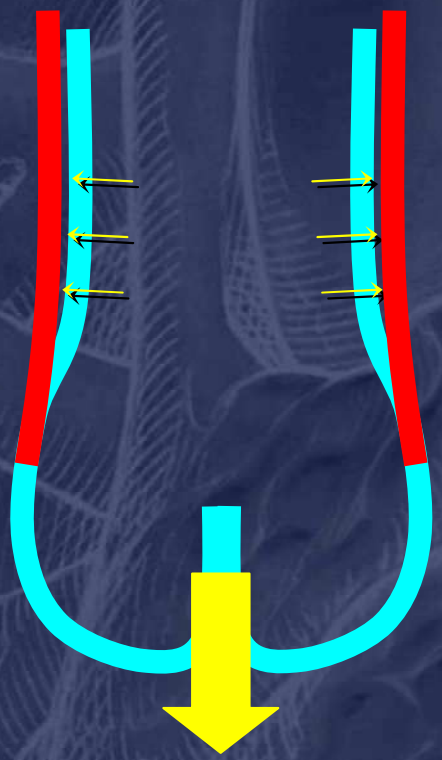


Free Margin Resuspension

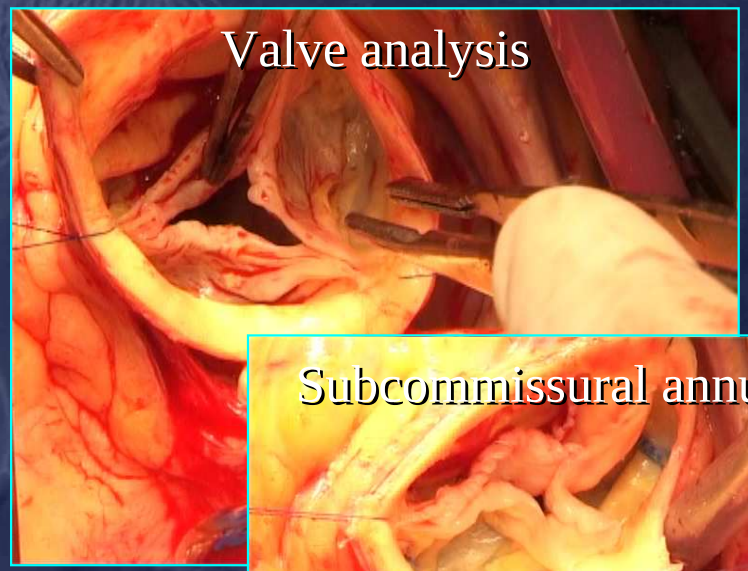
(with CV-7 PTFE suture)

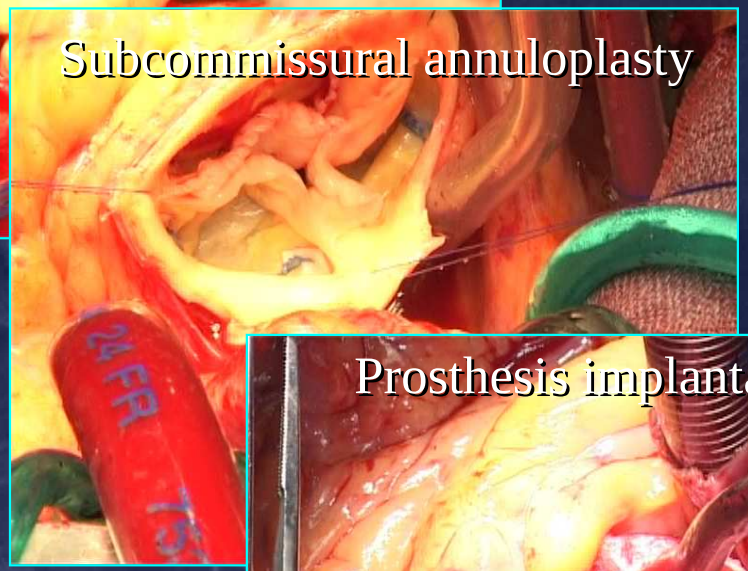


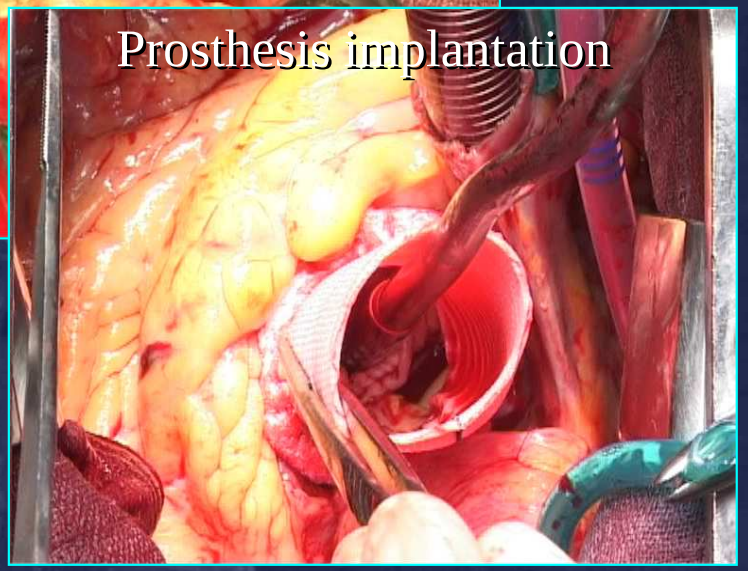
Type Ia + II repair



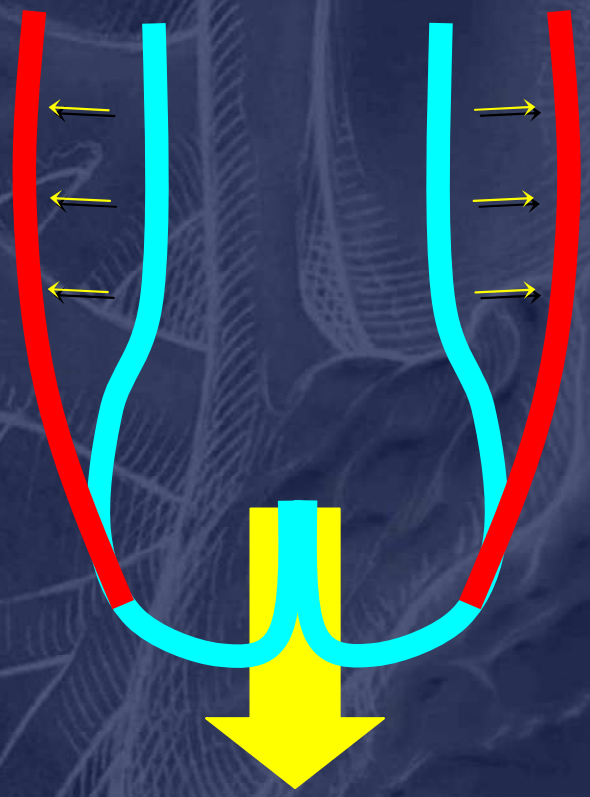
Sino-tubular junction dilatation



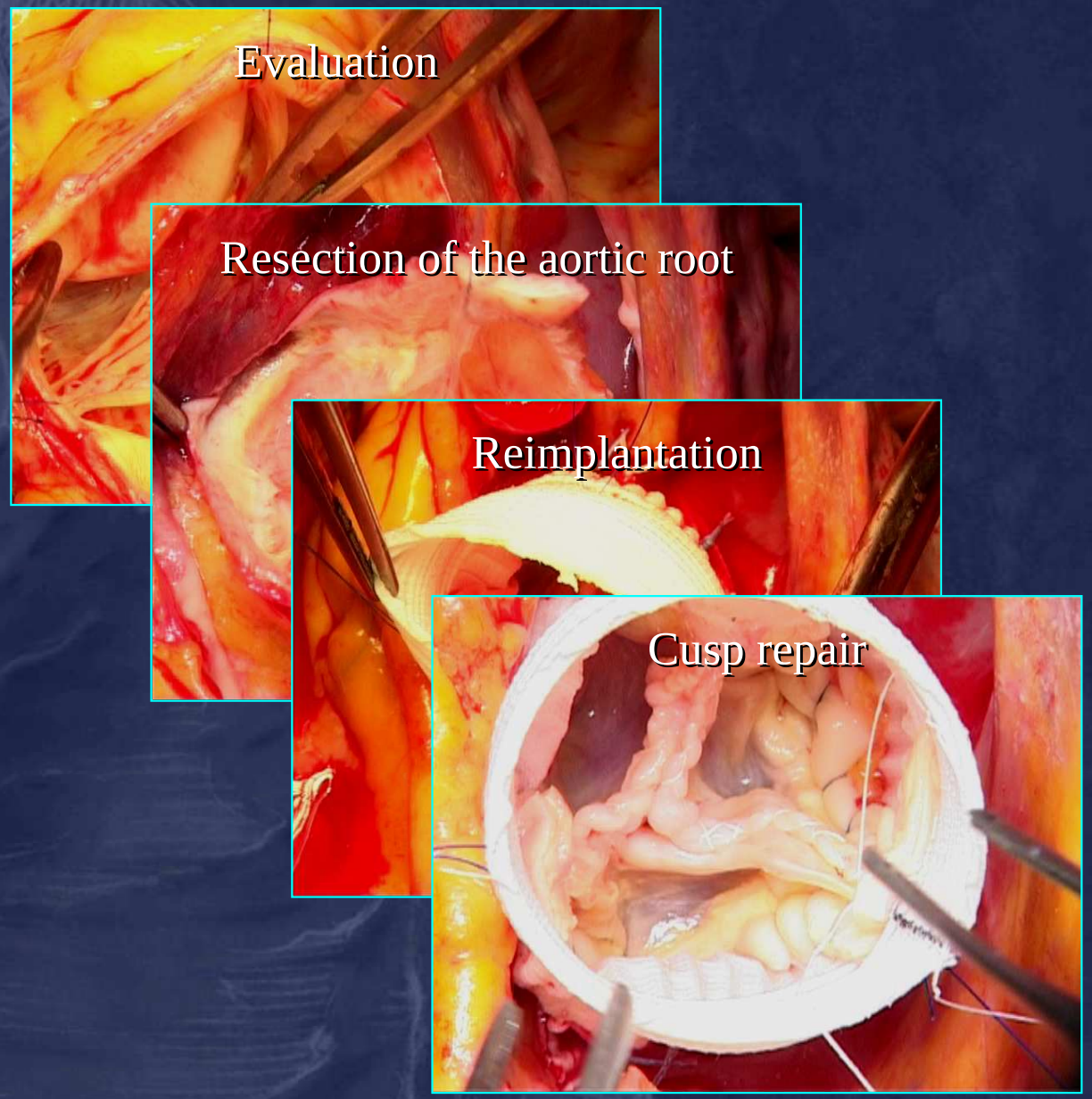




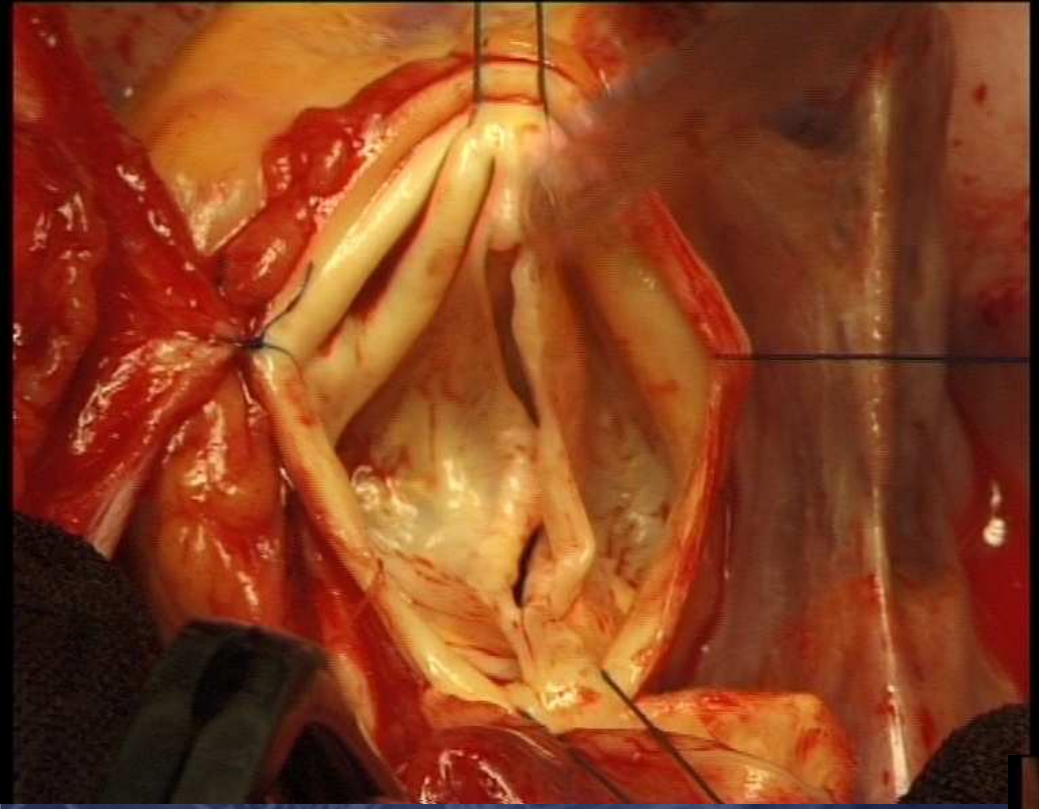
Type Ib + II repair



Aortic root aneurysm

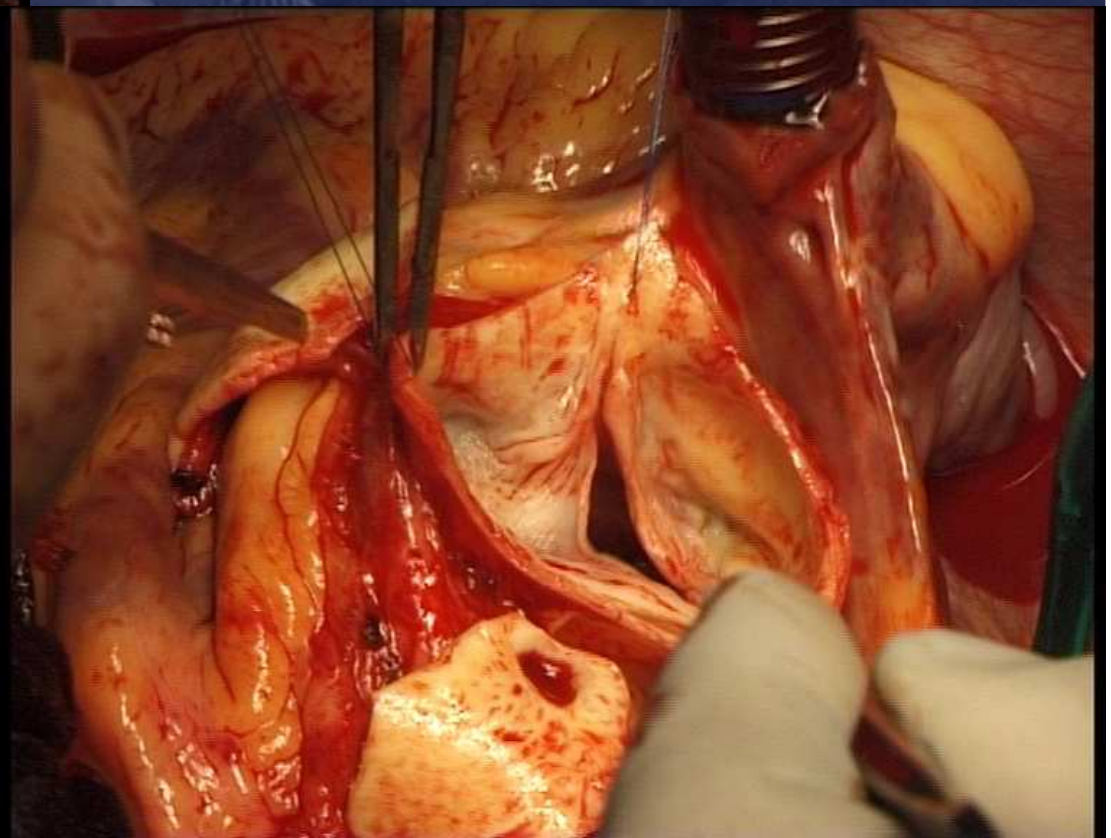


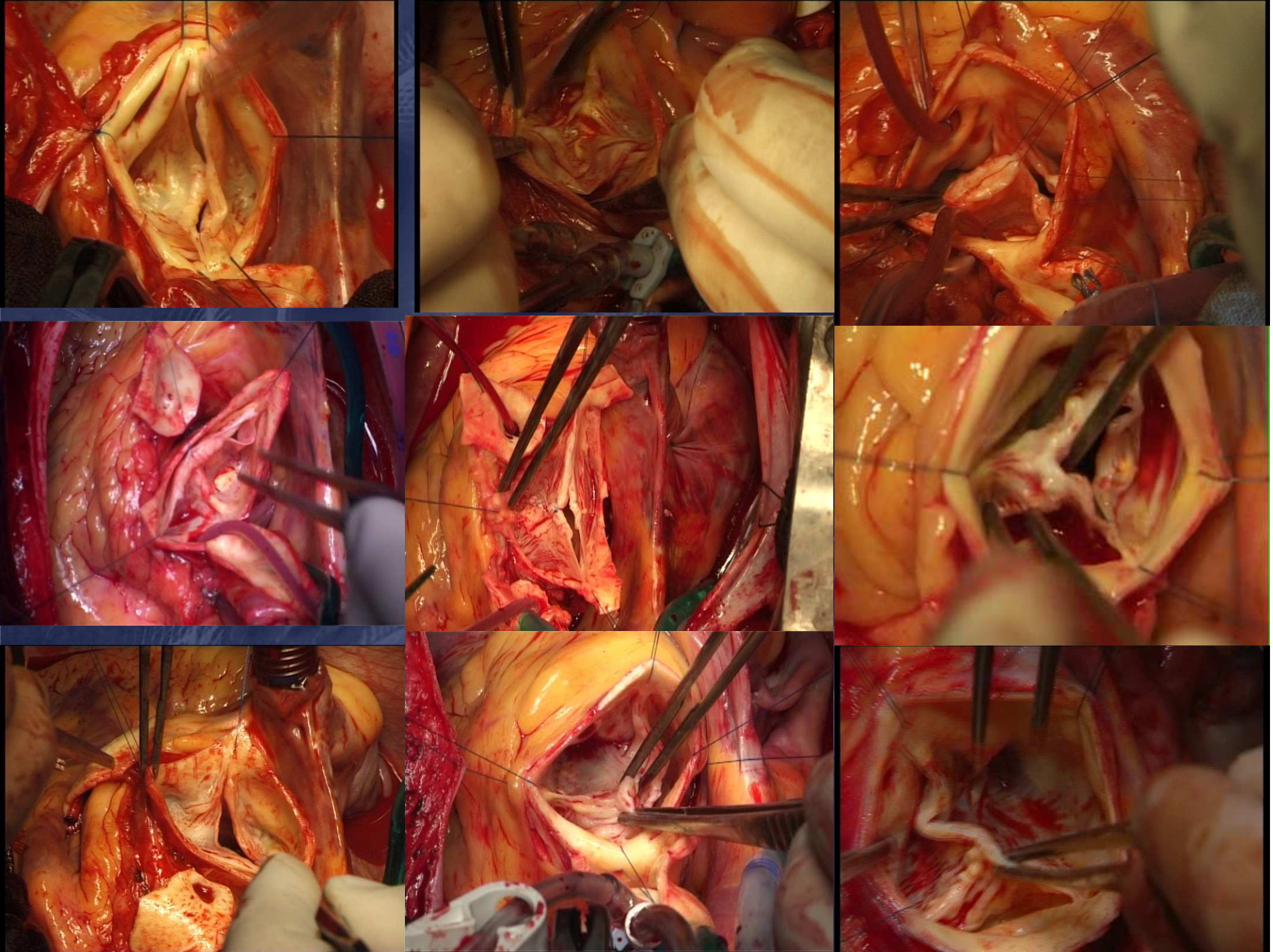
Bicuspid Aortic Valve



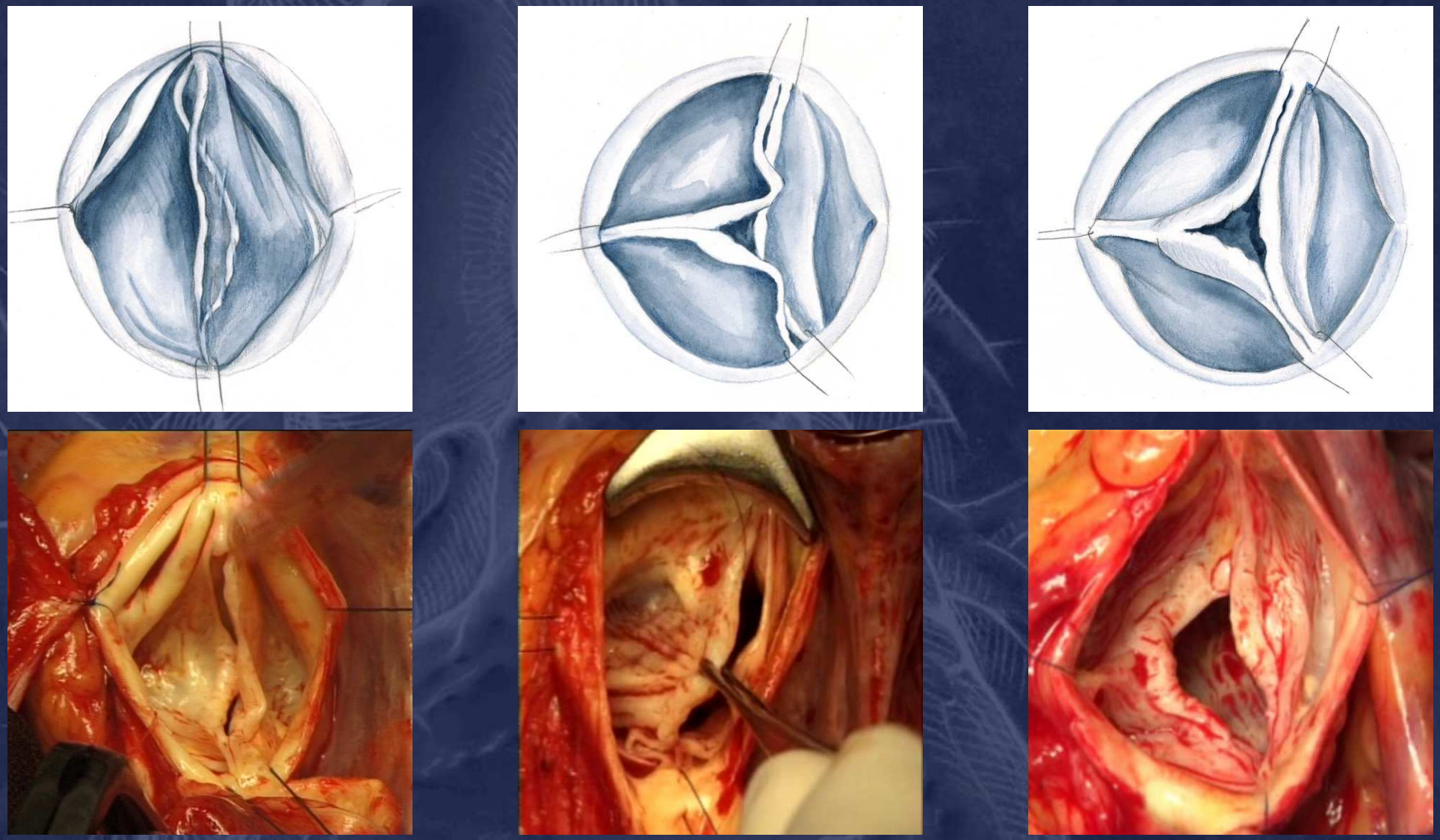
Leaflet disease

Root disease





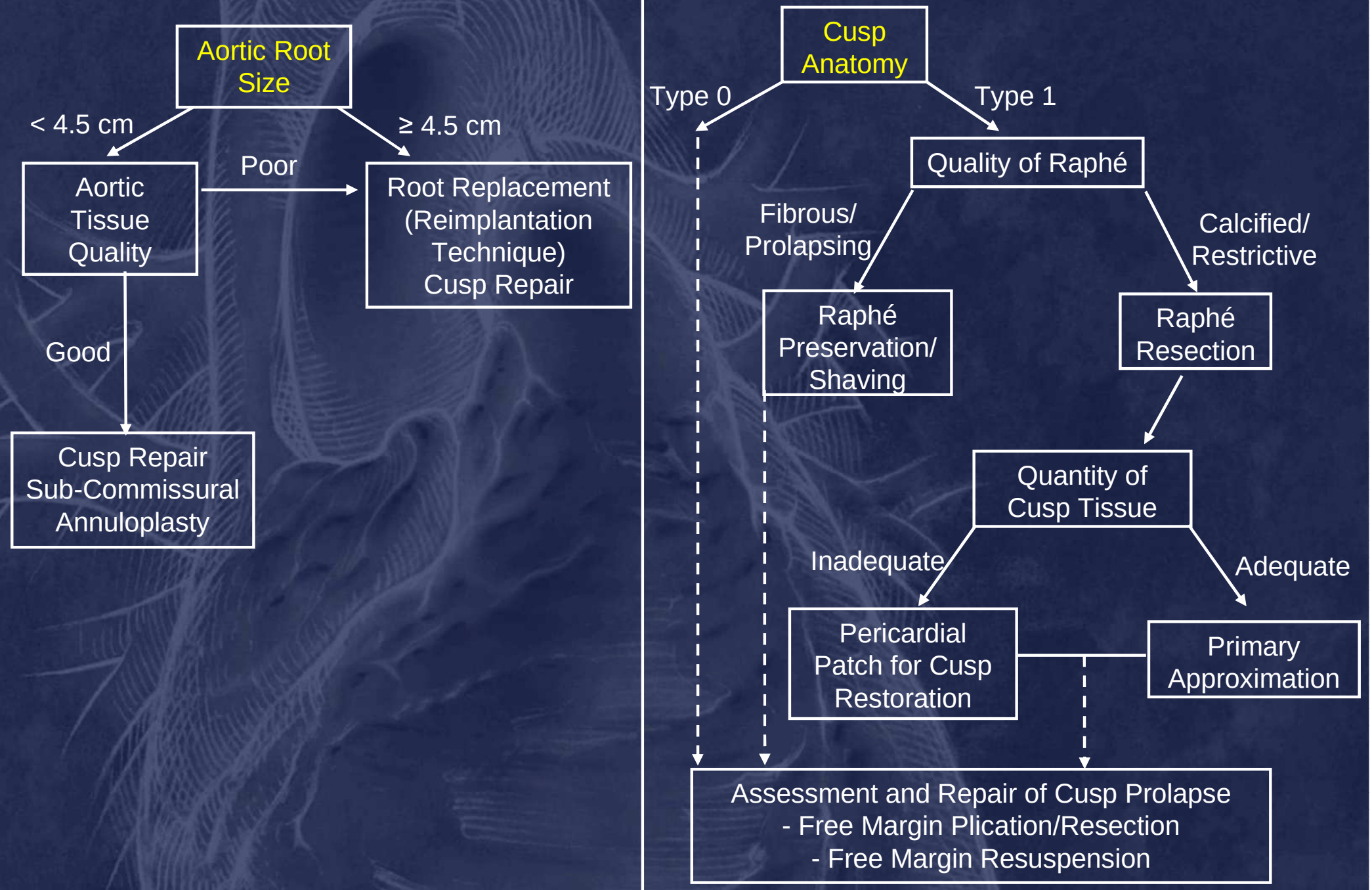
Cusp Anatomy

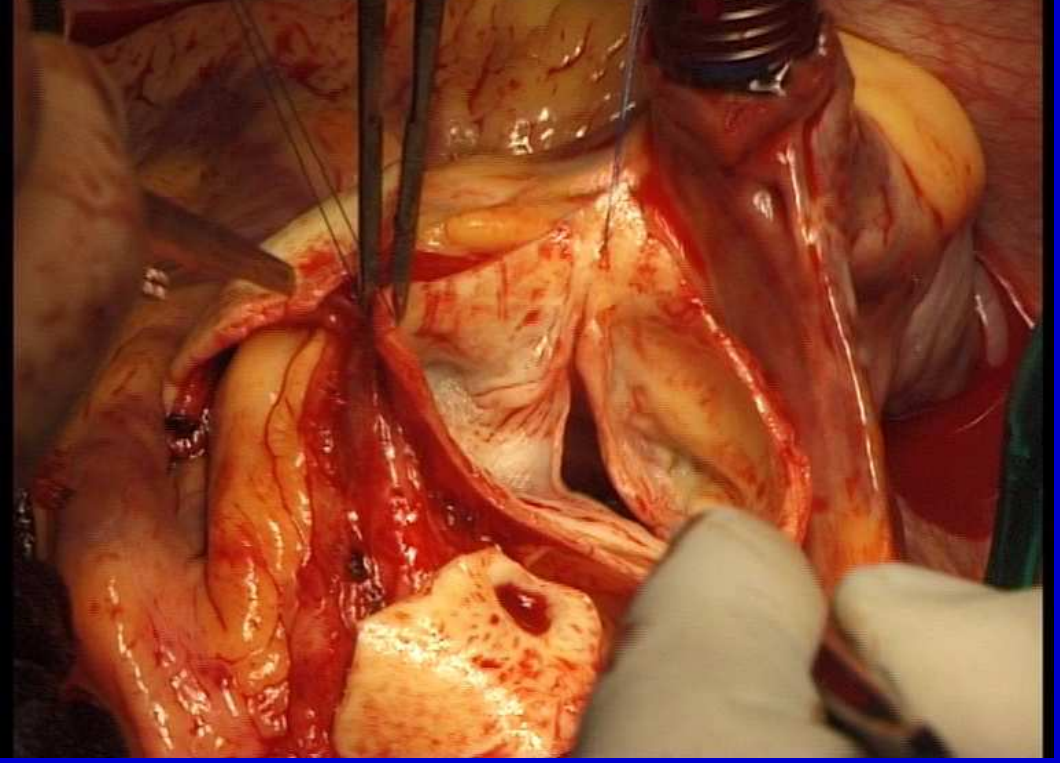


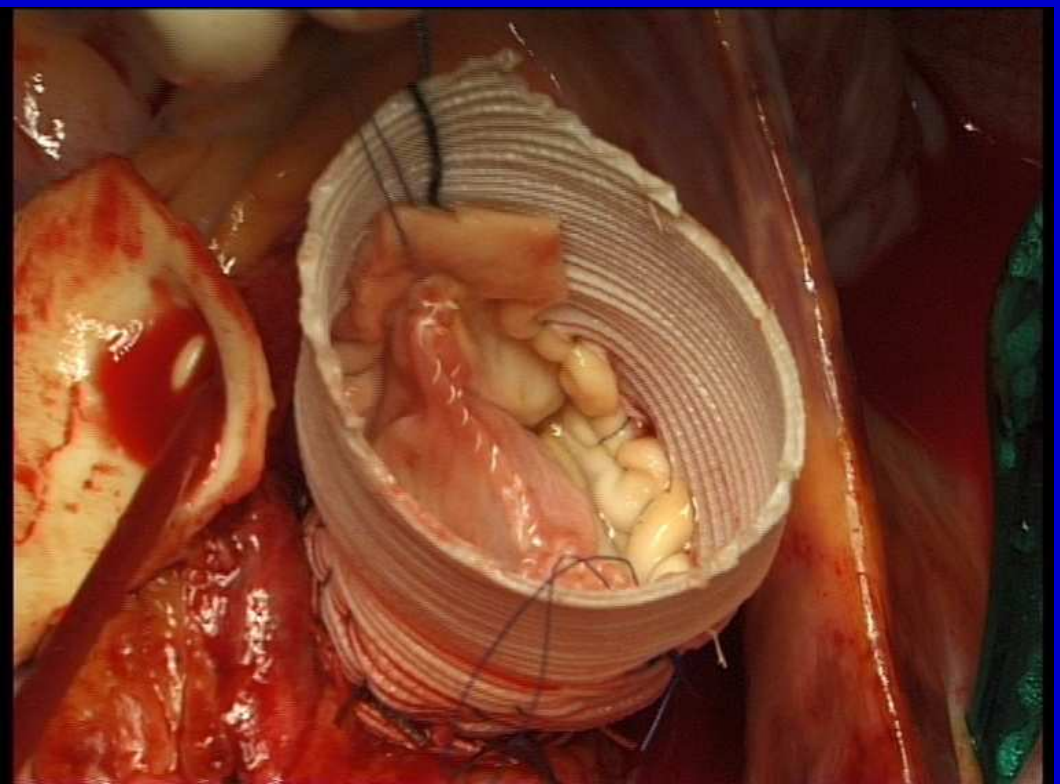
Type 0 | Type 1 (prolapsing) | Type 1 (restrictive)

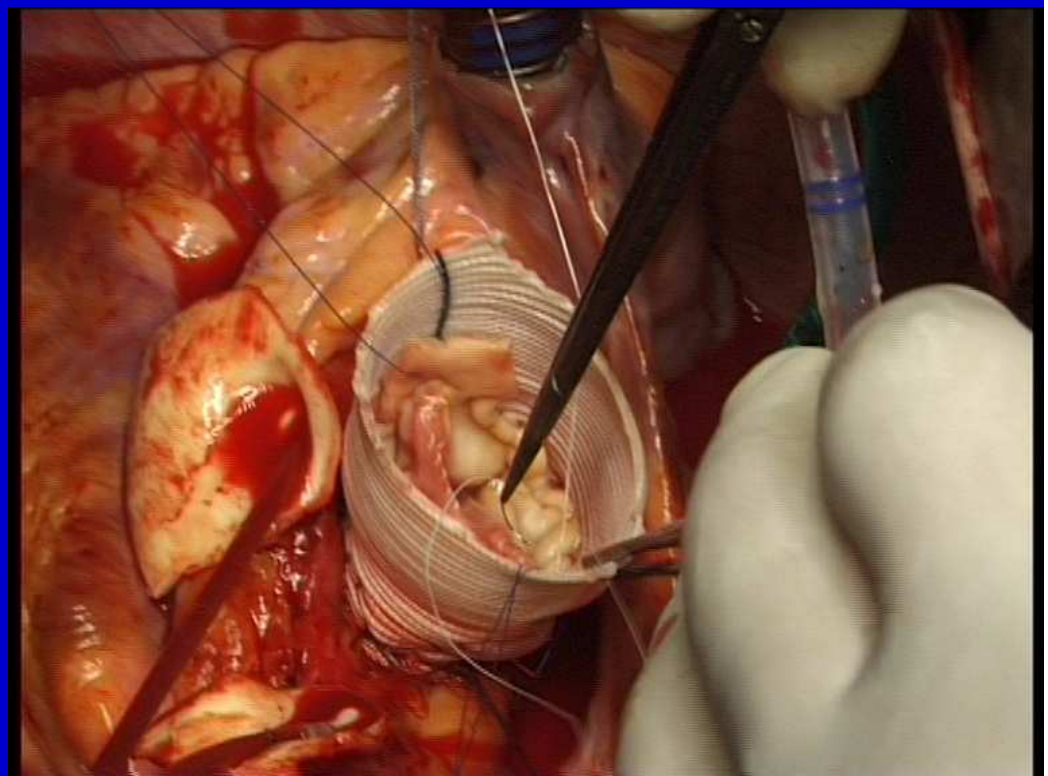
(Sievers et al. JTCVS 2007)

Algorithm for Systematic Approach to Bicuspid Aortic Valve Repair





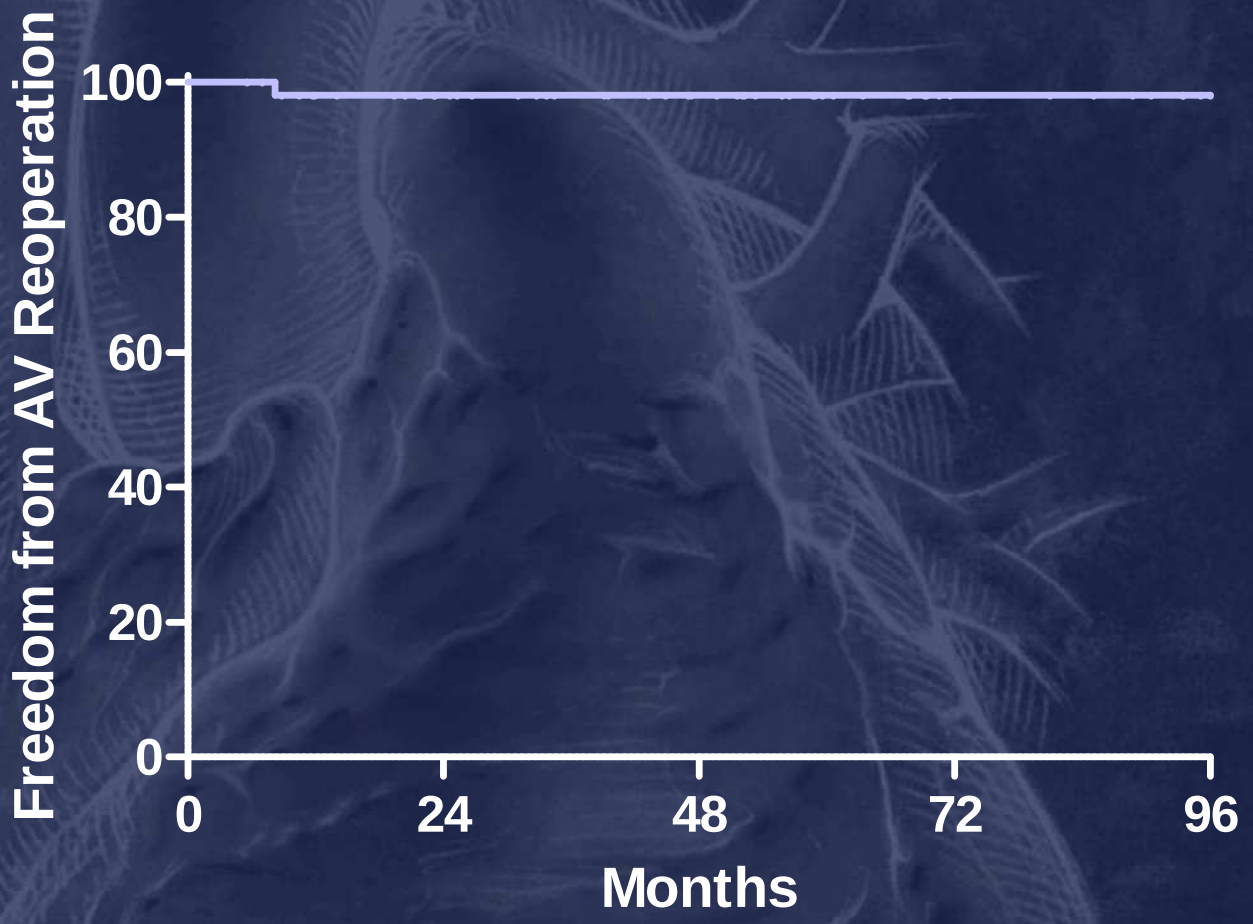




Are the results durable?

Supracoronary Ascending Aortic Aneurysms (Type 1A)

Freedom from AV Reoperation



No. at risk	55	41	28	10	3

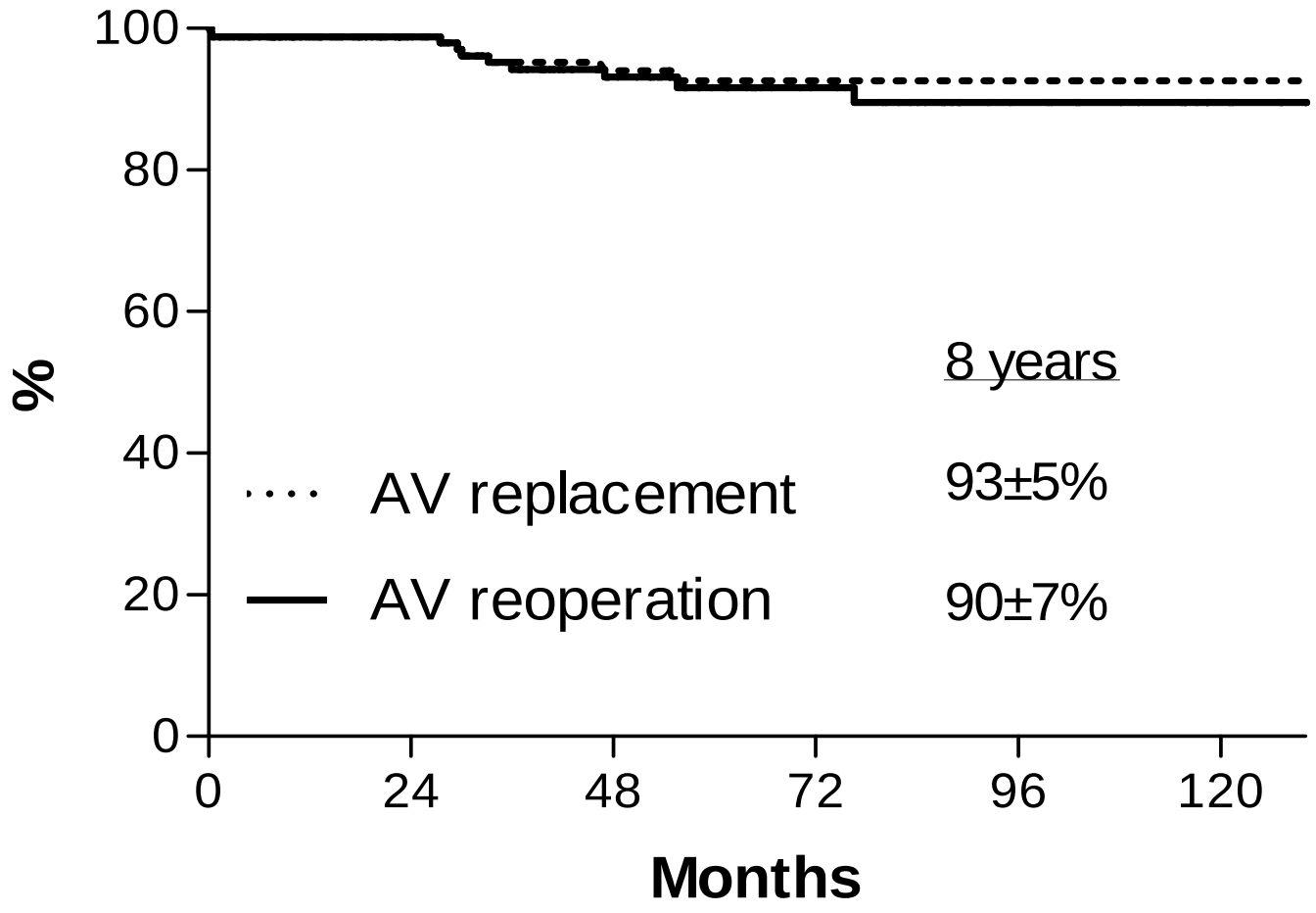
Valve Sparing Root Replacement (Type 1b)

Effects of preoperative aortic insufficiency on outcome after aortic valve-sparing surgery.

de Kerchove L, Boodhwani M, Glineur D, Poncelet A, Verhelst R, Astarci P, Lacroix V, Rubay J, Vandyck M, Vanoverschelde JL, Noirhomme P, El Khoury G.

Circulation. 2009 Sep 15;120(11 Suppl):S120-6.

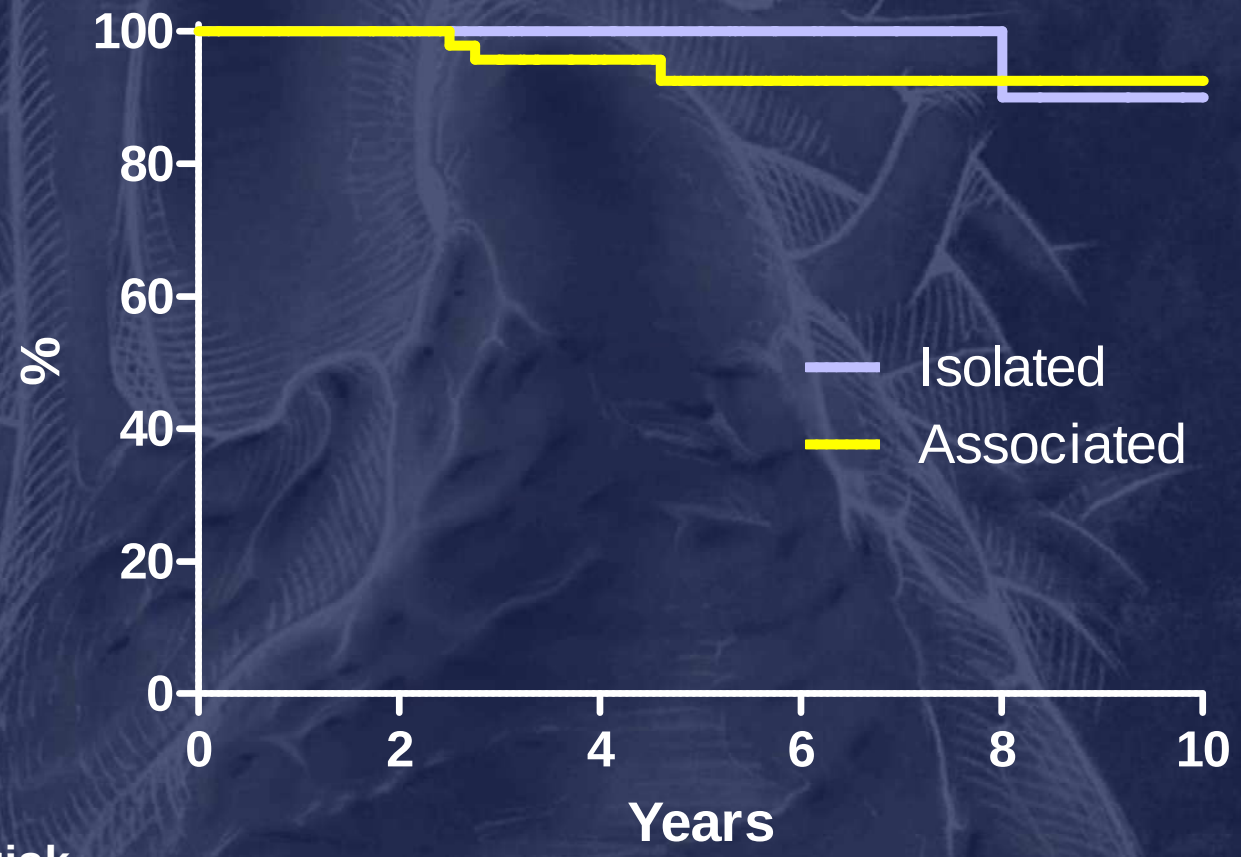
Freedom from AV Reoperation - Replacement



patients at risk:					
164	122	87	53	33	18

Cusp Prolapse Repair (Type 2)

Freedom from AV Reoperation



8 years

100%

93 ± 4%

No. at risk						
Isolated	50	43	30	18	11	7
Associated	61	56	35	17	7	4

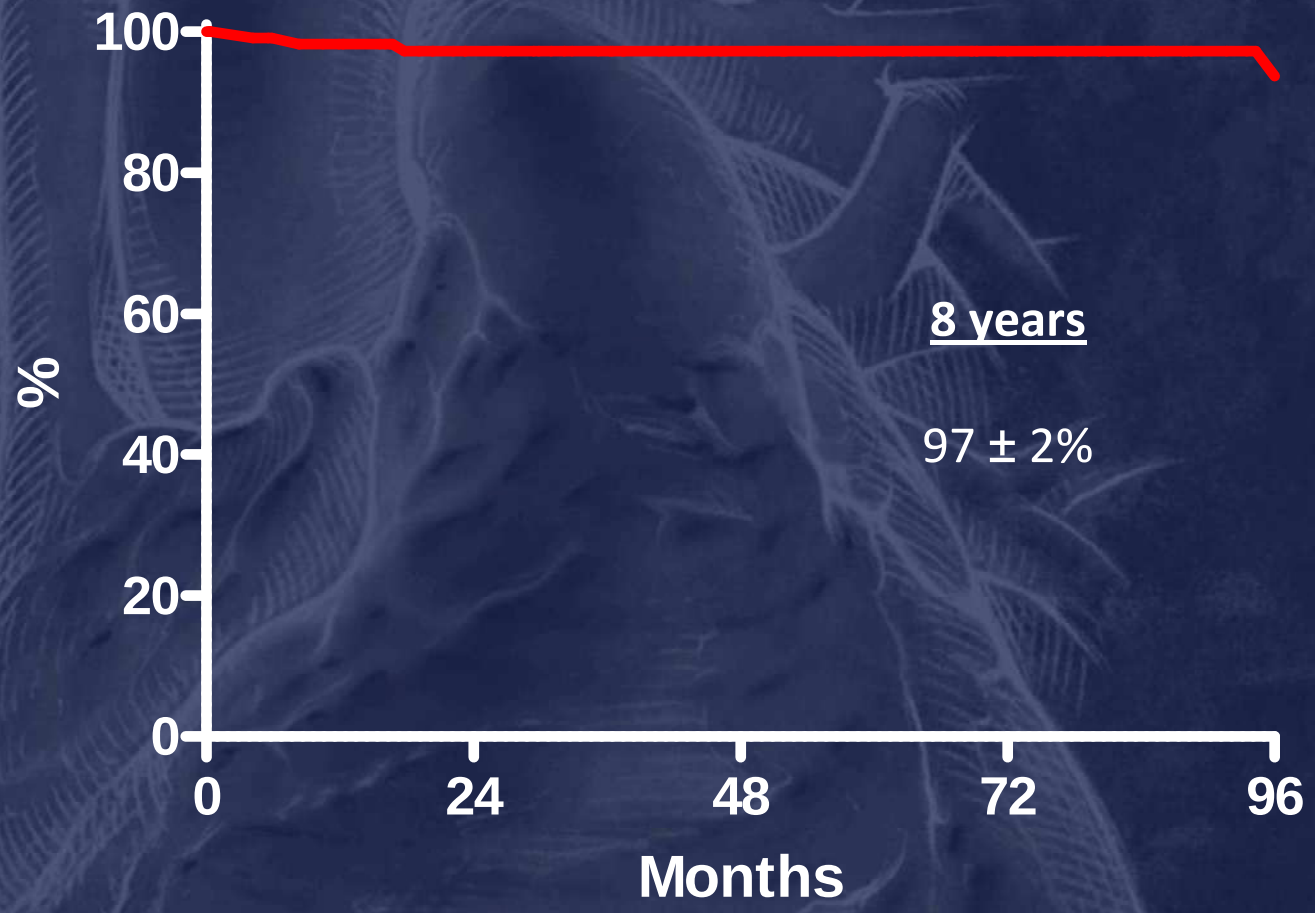
Bicuspid Aortic Valve Repair

Repair of regurgitant bicuspid aortic valves: A systematic approach.

Boodhwani M, de Kerchove L, Glineur D, Rubay J, Vanoverschelde JL, Noirhomme P, El Khoury G.

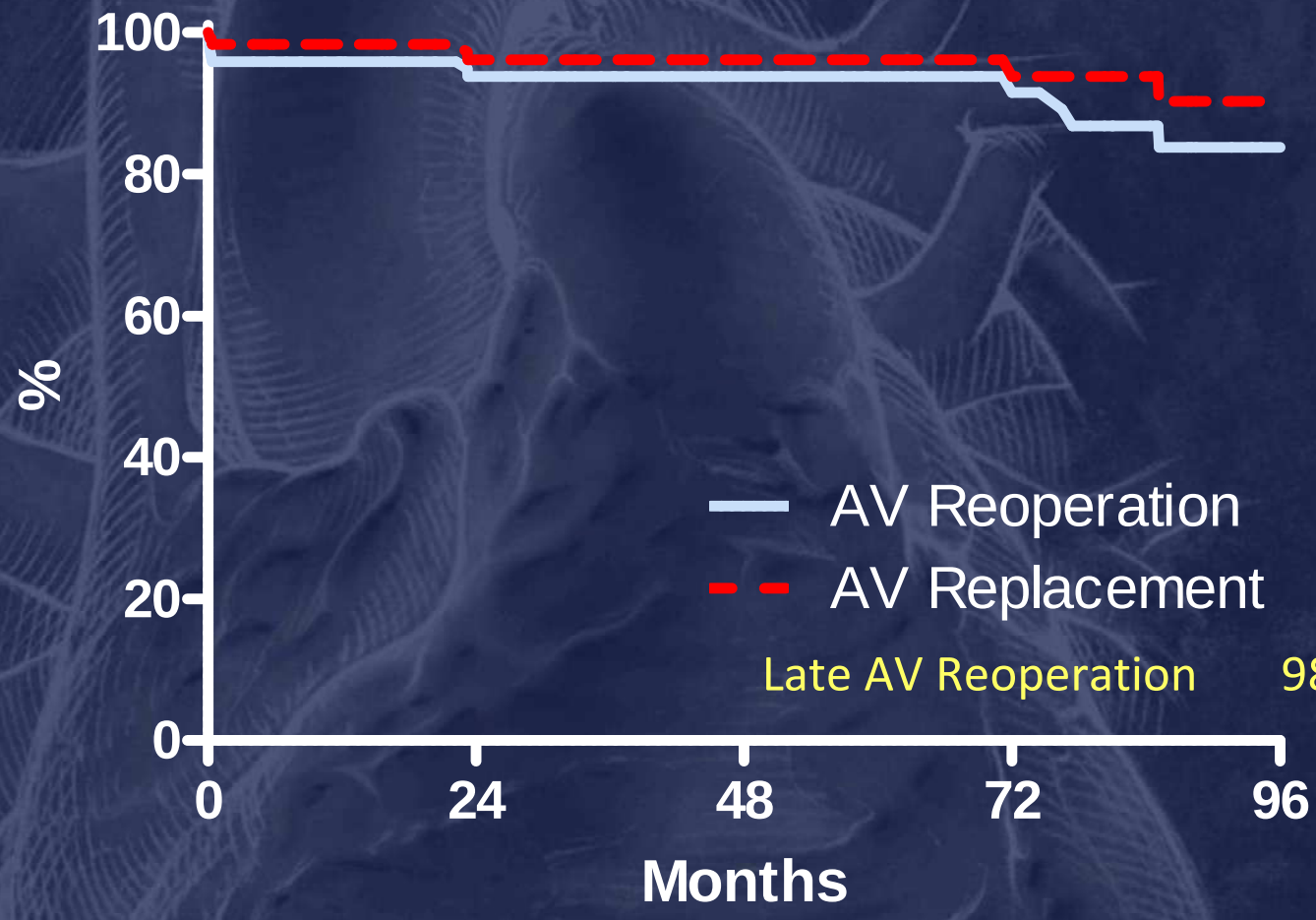
J Thorac Cardiovasc Surg. 2010 May 18.

Overall Survival



No. at risk	119	93	68	41	20

Freedom from Aortic Valve Reoperation



	5 years	8 years
AV Reoperation	94 ± 2%	83 ± 5%
AV Replacement	96 ± 2%	90 ± 5%
Late AV Reoperation	98 ± 2%	87 ± 5%

No. at risk	122	92	68	41	20

Aortic Valve Repair: Why Not?

Question # 1

Can the valve be repaired?

Quesiton # 2

Should the valve be repaired?

Bioprosthetic Valves:

Durability

Hancock II Bioprosthesis for Aortic Valve Replacement: The Gold Standard of Bioprosthetic Valves Durability?

Tirone E. David, MD, Susan Armstrong, MS, and Manjula Maganti, MS

Division of Cardiovascular Surgery of Peter Munk Cardiac Centre, Toronto General Hospital and University of Toronto, Toronto, Ontario, Canada

Background. This study examined the long-term durability of the Hancock II bioprosthesis (Medtronic, Minneapolis, MN) in the aortic position.

Methods. From 1982 to 2004, 1134 patients underwent aortic valve replacement (AVR) with Hancock II bioprosthesis and were prospectively monitored. Mean patient age was 67 ± 11 years; 202 patients were younger than 60, 402 were 60 to 70, and 526 were older than 70. Median follow-up was 12.2 years and 99.2% complete. Valve function was assessed in 94% of patients. Freedom from adverse events was estimated by the Kaplan-Meier method.

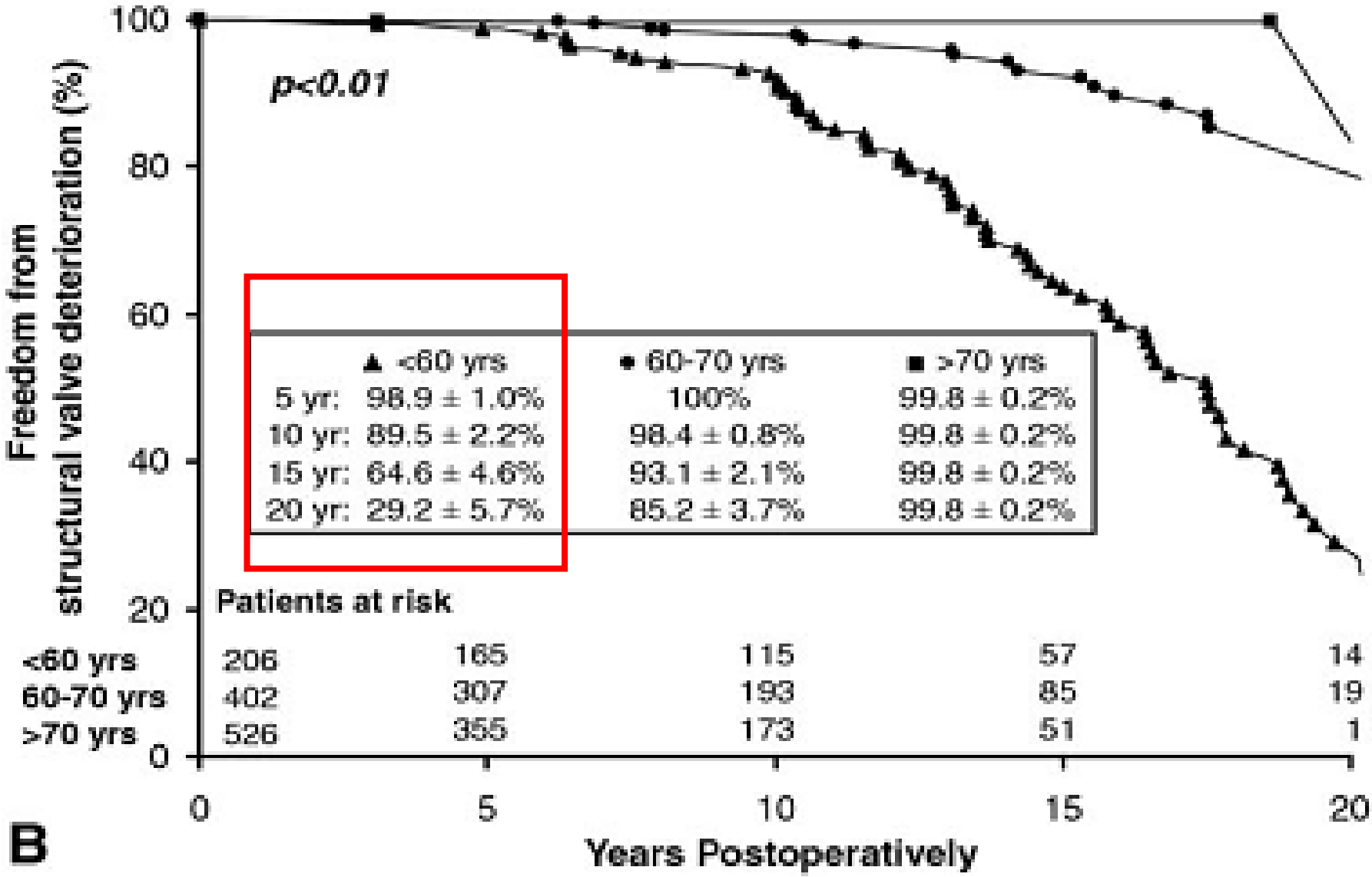
Results. Survival at 20 and 25 years was 19.2% ± 2% and 6.7% ± 2.8%, respectively, with only 34 and 3 patients at risk. Survival at 20 years was 54.9% ± 6.4% in patients younger than 60 years, 22.7% ± 3.3% in those 60 to 70, and 2.4% ± 1.9% in those older than 70 ($p = 0.01$). Structural valve deterioration developed in 67 patients aged younger than 60, in 18 patients aged 60 to 70, and in 2 patients older than 70. The freedom from structural valve deterioration at 20 years was 63.4% ± 4.2% in the entire cohort, 29.2% ± 5.7% in patients younger than 60 years, 83.2% ± 3.7% in patients aged 60 to 70, and 99.8% ± 0.2% in patients older than 70 (truncated at 18 years). Repeat AVR was performed in 104 patients (74 for structural valve failure, 16 for endocarditis, and 14 for other reasons). At 20 years, the overall freedom from AVR was 65.1% ± 4% for any reason, 29.8% ± 5.4% in patients younger than 60 years, 86.8% ± 3.3% in patients 60 to 70, and 98.3% ± 0.6% in patients older than 70.

Conclusions: Hancock II bioprosthesis is a very durable valve in patients 60 years and older and is probably the gold standard of bioprosthetic valve durability in this patient population.

(Ann Thorac Surg 2010;90:775–81)

David et. al. Ann Thorac Surg 2010;90:775-81

Durability



David et. al. Ann Thorac Surg 2010;90:775-81

Durability

Late Outcomes for Aortic Valve Replacement With the Carpentier-Edwards Pericardial Bioprosthesis: Up to 17-Year Follow-Up in 1,000 Patients

R. Scott McClure, MD, SM, Narendren Narayanasamy, MD, Esther Wiegerinck, BA, Stuart Lipsitz, ScD, Ann Maloney, BA, John G. Byrne, MD, Sary F. Aranki, MD, Gregory S. Couper, MD, and Lawrence H. Cohn, MD

Division of Cardiac Surgery, Brigham and Women's Hospital, and Center for Surgery and Public Health, Harvard Medical School, Boston, Massachusetts

Background. This study reviews a single institution experience with the Carpentier-Edwards pericardial aortic valve bioprosthesis, concentrating on late outcomes.

Methods. From December 1991 to June 2002, 1,000 patients underwent aortic valve replacement with the Carpentier-Edwards pericardial valve (mean follow-up 6.01 ± 3.56 years). The institutional database was reviewed. Follow-up data were acquired through telephone interviews and mail-in questionnaires. Time-to-event analyses were performed by the Kaplan-Meier method. Mean age was 74.1 years; 545 patients (54.5%) were male. Mean preoperative ejection fraction was 52.5%. Isolated aortic valve replacement occurred in 372 cases (37.2%). Combined aortic valve replacement with coronary artery bypass grafting occurred in 443 cases (44.3%). The remaining 185 patients (18.5%) underwent complex procedures with concomitant mitral, tricuspid, or arch repair. One hundred forty patients (14.0%) had prior aortic valve surgery. Follow-up was 99.4% complete.

Results. Overall operative mortality was 7.2% (72 of 1,000). There were 503 late deaths (50.3%). Age-stratified survival at 15 years was 43.7% for patients less than 65 years of age; 18.2% for patients aged 65 to 75; and 9.4% for patients aged more than 75 years. There were 26 failed bioprostheses (2.6%) requiring reoperation. Structural valve deterioration was the cause in 13 of 26 cases (50%), endocarditis in 11 of 26 (42%), and perivalvular leak in 2 of 26 (7.6%). Age-stratified freedom from reoperation due to structural valve deterioration at 15 years was 34.7% for patients less than 65 years of age; 89.4% for patients aged 65 to 75; and 99.5% for patients aged more than 75 years.

Conclusions. The Carpentier-Edwards pericardial bioprosthesis shows long-term durability with low rates of structural failure.

(Ann Thorac Surg 2010;89:1410–6)

McClure et. al. Ann Thorac Surg 2010;89:1410–6

Durability

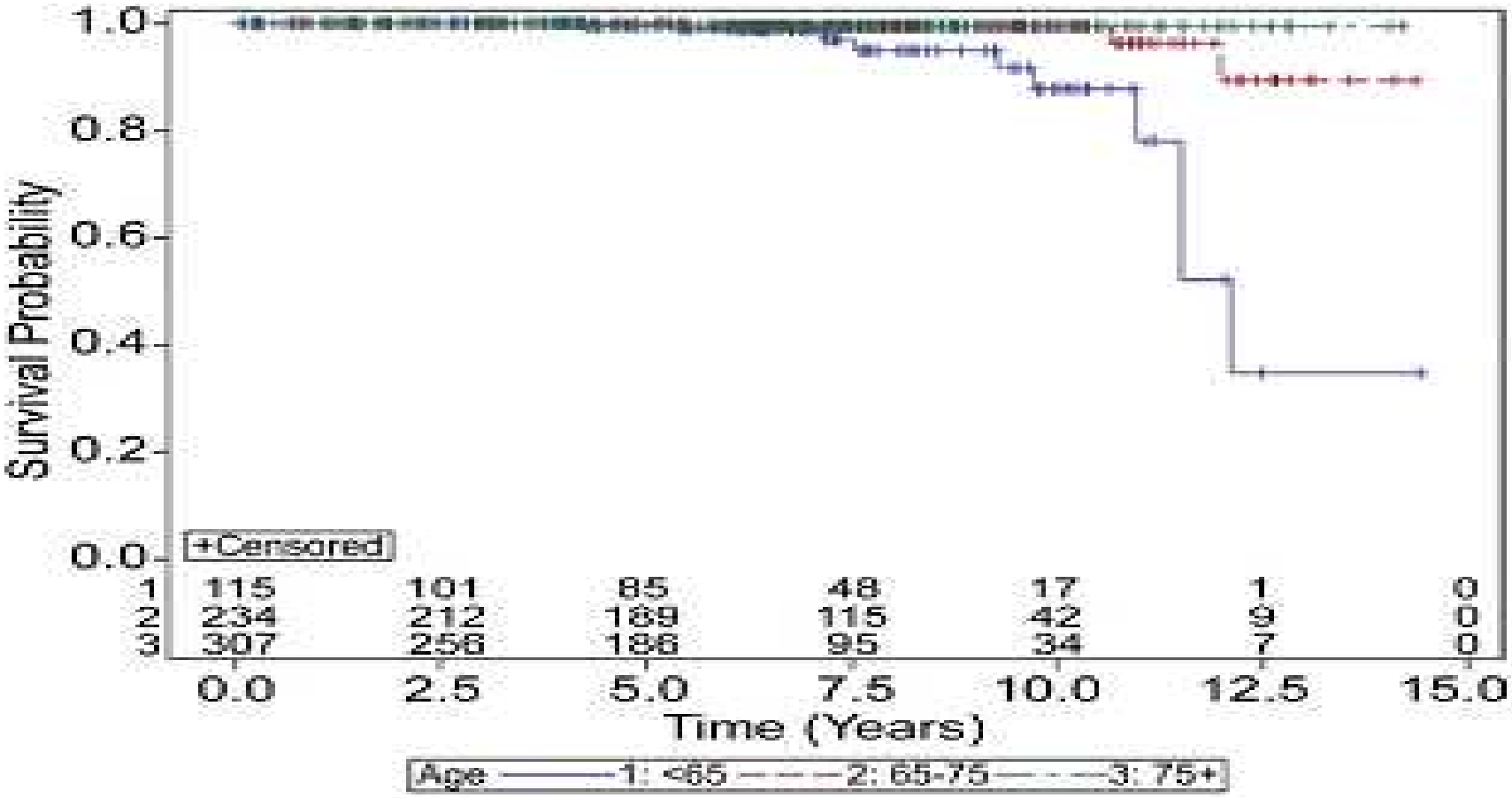


Fig 2. Age-stratified freedom from structural valve deterioration necessitating reoperation using the Carpentier-Edwards pericardial aortic bioprosthesis. (Blue line = age less than 65 years; red line = age 65 to 75 years; green line = age 75 years or more.)

McClure et. al. Ann Thorac Surg 2010;89:1410–6

Patient Selection: Age

Institutional experience of 476 patients:

- Mean age 53 ±16 (range 6 - 86 years)
- <65 years: 74%
- >65 years: 26%
- >80 years: 11%

Durability of Repair vs. Replacement

- Bioprosthetic valves degenerate faster in younger patients
  - Age < 50 : 3.7% / pt-year
  - Age 50 – 60 : ~2% / pt-year

    (Jamieson WR J Thorac Cardiovasc Surg 2005;130:994-1000.)

Valve Related Complications

- Thromboembolism:
  - Bioprosthesis = Mechanical : 1-2% / pt-year
  - Higher following Mechanical Bentall (upto 10%/pt-yr)
  - Repair : 0.4%/ pt-year
- Bleeding Events
  - Mechanical valves : ~2%/ pt-year
- Endocarditis
  - Very low with repair (~0.1%/pt-year)

Conclusion

Should the Aortic Valve be repaired?

1. ***If a durable repair is feasible***
2. ***If the patient stands to benefit from reduced valve-related complications***

Why Not?