

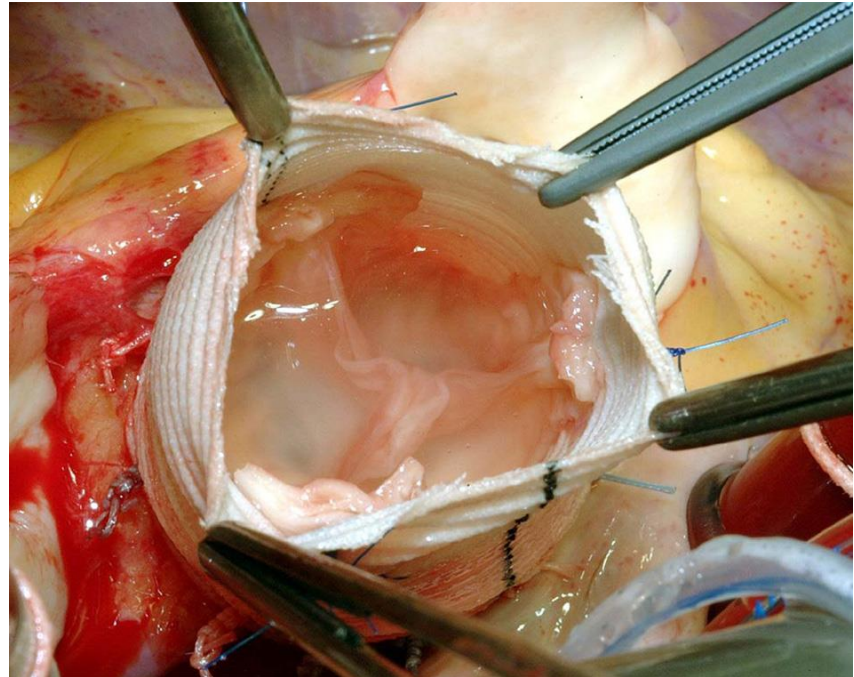
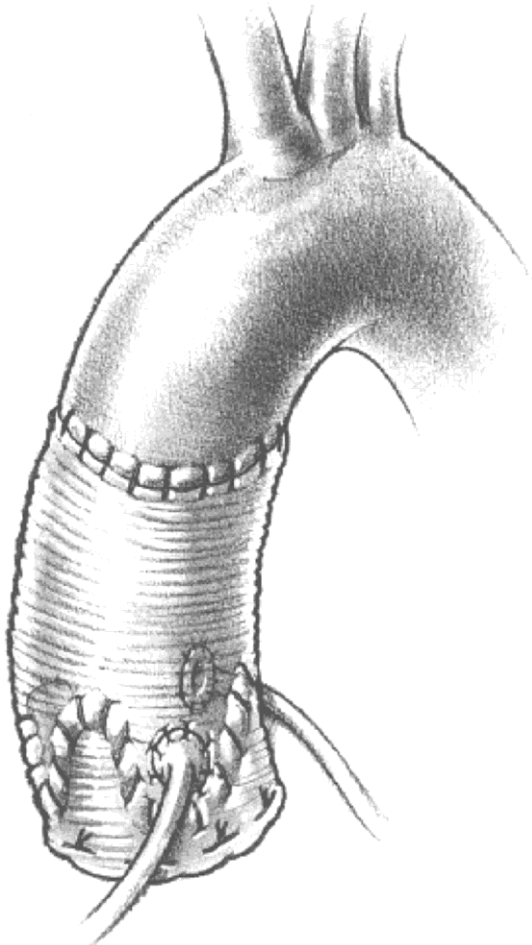
Aortic Valve Reimplantation



Prof. Dr. med. Torsten Doenst
Department of Cardiothoracic Surgery

Aortic Valve Reimplantation

a.k.a David Operation



Initial Report

An aortic valve-sparing operation for patients with aortic incompetence and aneurysm of the ascending aorta TE David and CM Feindel

Division of Cardiovascular Surgery, University of Toronto, Ontario, Canada.

A number of patients who require an operation for complications of annuloaortic ectasia, such as aortic incompetence or aneurysm of the aortic root (or both), have normal aortic valve leaflets. We have treated these patients by excising the aneurysmal portion of the ascending aorta and sinuses of Valsalva but by leaving the aortic valve leaflets and some arterial wall attached to the left ventricular outflow tract. The aortic valve is reimplanted inside a collagen-impregnated tubular Dacron graft, similar to what is done for implantation of an aortic valve homograft. The coronary arteries are also reimplanted. This operation was performed in 10 patients. All patients had annuloaortic...



Chris „deBono“ Feindel

The Journal of Thoracic and Cardiovascular Surgery, 1992, 103, 617- 621

A quarter of a century of experience with aortic valve-sparing operations

Tirone E. David, MD, Christopher M. Feindel, MD, Carolyn M. David, BN, and Cedric Manlhiot, BSc

Objective: To examine the late outcomes of aortic valve-sparing operations to treat patients with aortic root aneurysm with and without aortic insufficiency (AI) in a cohort of patients followed up prospectively since 1988.

Methods: A total of 371 consecutive patients had undergone aortic valve-sparing surgery (mean age, 47 ± 15 years; 78% men) from 1988 through 2010. In addition to the aortic root aneurysm, 47% had moderate or severe AI, 35.5% had Marfan syndrome, 12.1% had type A aortic dissection, 9.2% had bicuspid aortic valve, 8.4% had mitral insufficiency, 16.1% had aortic arch aneurysm, and 10.2% had coronary artery disease. Reimplantation of the aortic valve was used in 296 patients and remodeling of the aortic root in 75. Cusp repair by plication of the free margin along the nodule of Arantius was used in 36.6% of patients, and reinforcement of the free margin with a double layer of fine Gore-Tex suture in 24.2%. The patients were followed up prospectively with images of the aortic root for a median follow-up of 8.9 ± 5.2 years.

Results: A total of 4 operative and 39 late deaths occurred. Survival at 18 years was $76.8\% \pm 4.31\%$, lower than that for the general population matched for age and gender. Age, type A aortic dissection, impaired ventricular function, and preoperative AI were associated with increased mortality on multivariable analysis. Reoperations on the aortic valve were performed in 8 patients for recurrent AI and in 2 for infective endocarditis. Freedom from reoperation on the aortic valve at 18 years was $94.8\% \pm 2.0\%$. No predictors of the need for reoperation were found on multivariable analysis. Eighteen patients developed AI greater than mild. Freedom from AI greater than mild at 18 years was $78.0\% \pm 4.8\%$. No predictors of recurrent AI were identified on multivariable analysis.

Conclusions: Aortic valve-sparing operations continue to provide excellent clinical outcomes, although a slow but progressive deterioration of aortic valve function seems to occur during the first 2 decades of follow-up. Preoperative AI and cusp repair had no adverse effect on valve function. (J Thorac Cardiovasc Surg 2014;148:872-80)

„Participation in the Experience“



Fellows at Toronto General Hospital 2003/2004

Anatomy of the Aortic Root

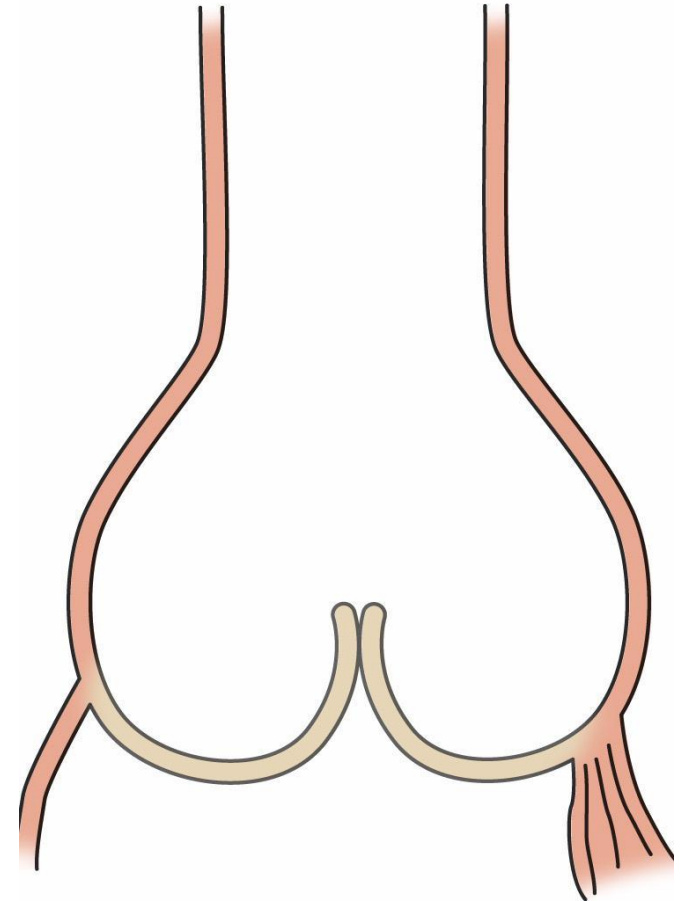
Anatomic Components of the Aortic Root:

Sinotubular Junction (STJ)

Sinus of Valsalva

Valve Cusps

Annulus



Mode of Aortic Valve Dysfunction

Dilatation of STJ

→ AR

Cusp Anomaly

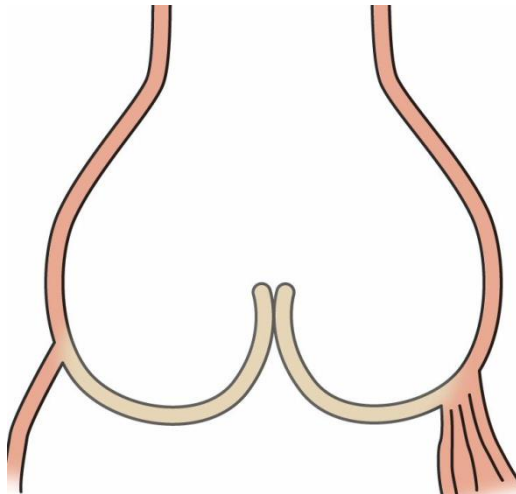
→ AR or AS

Dilatation of Annulus

→ AR

Dilatation of Sinus of Valsalva

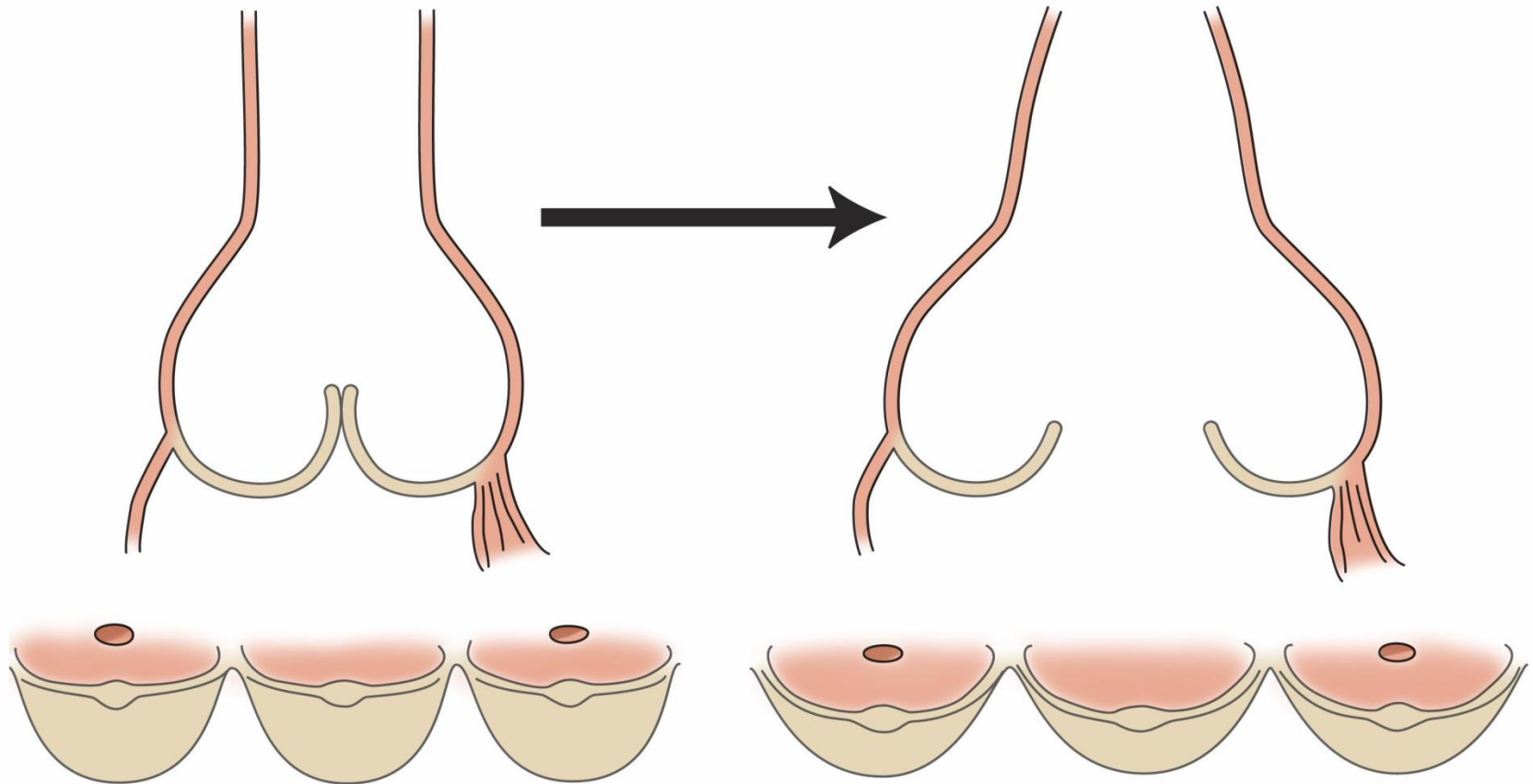
→ None



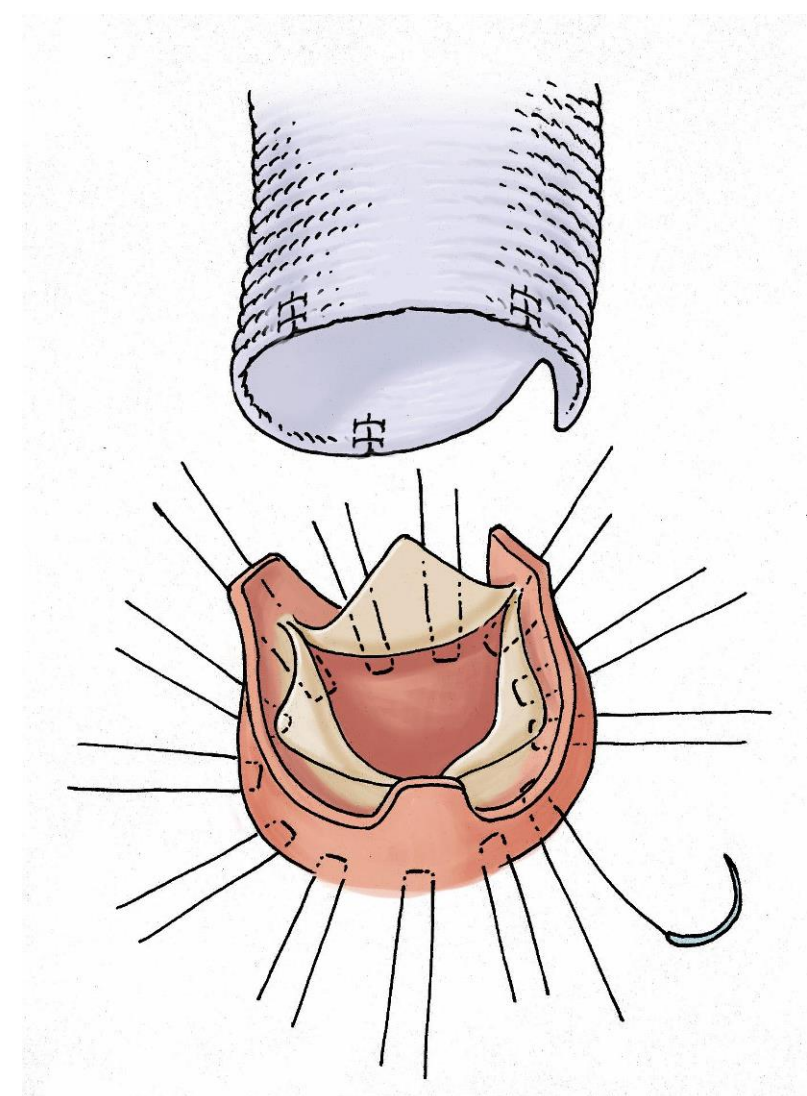
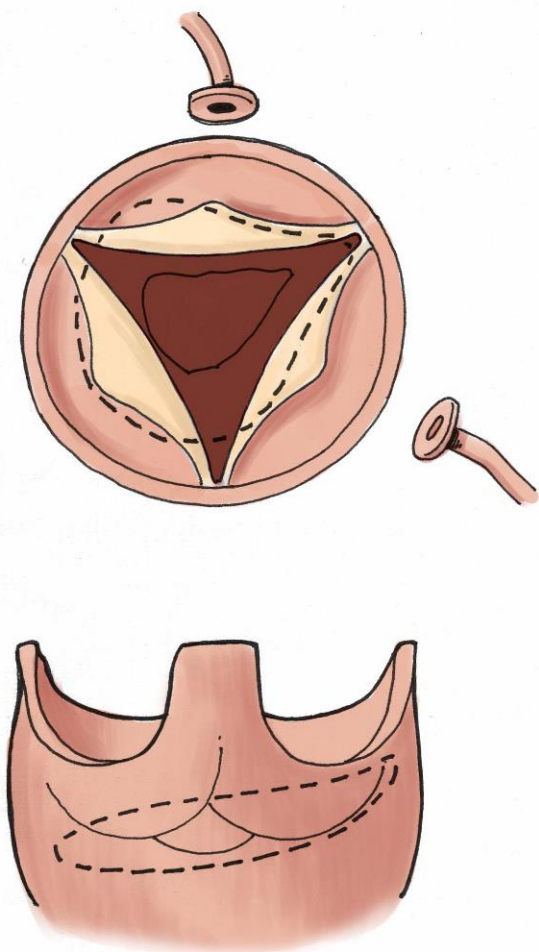
AR = Aortic Regurgitation

AS = Aortic Stenosis

AR: Aortic Root Aneurysm with Annuloaortic Ectasia

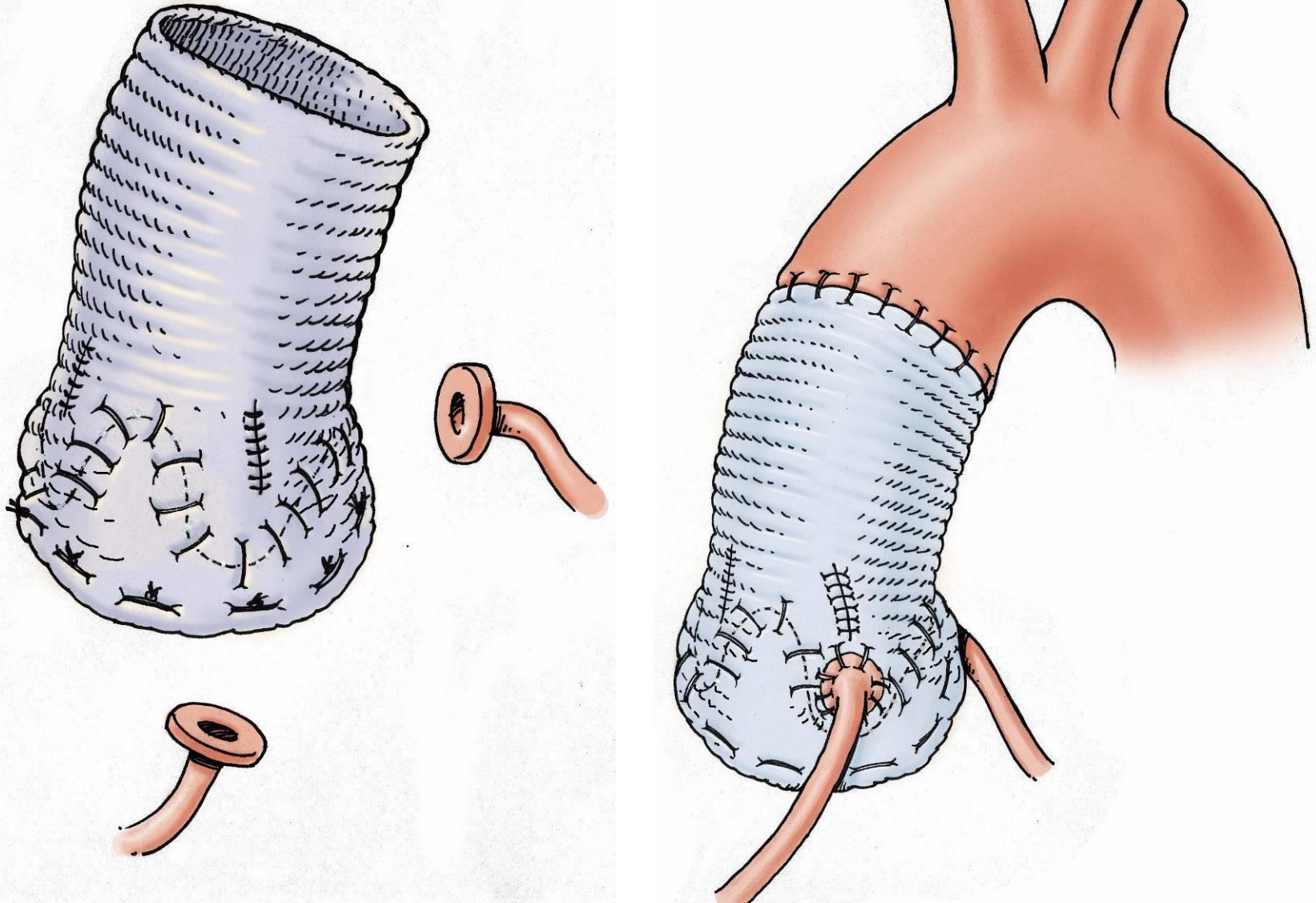


Reimplantation of the Aortic Valve (David Procedure)

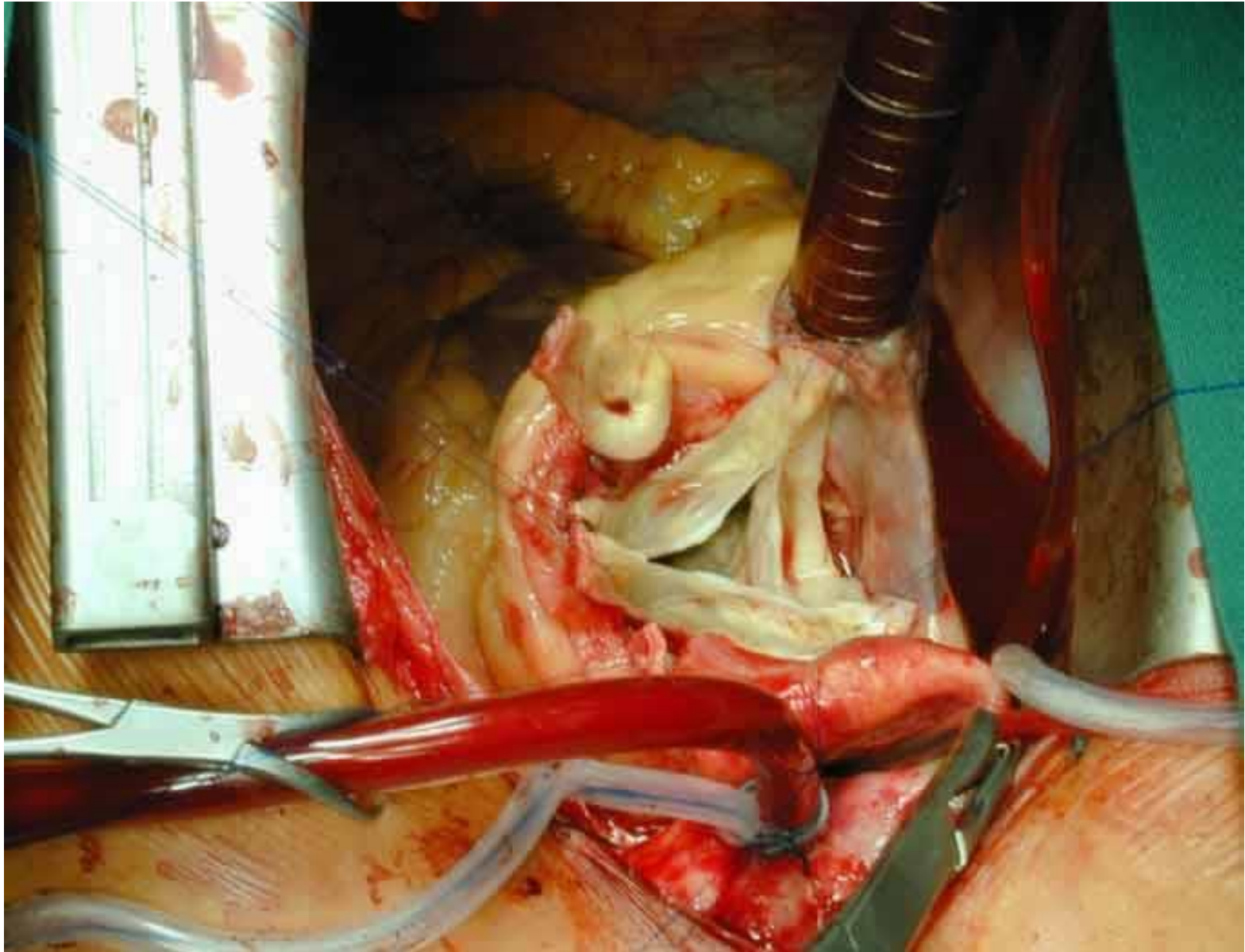


Reimplantation of the Aortic Valve (David Procedure)

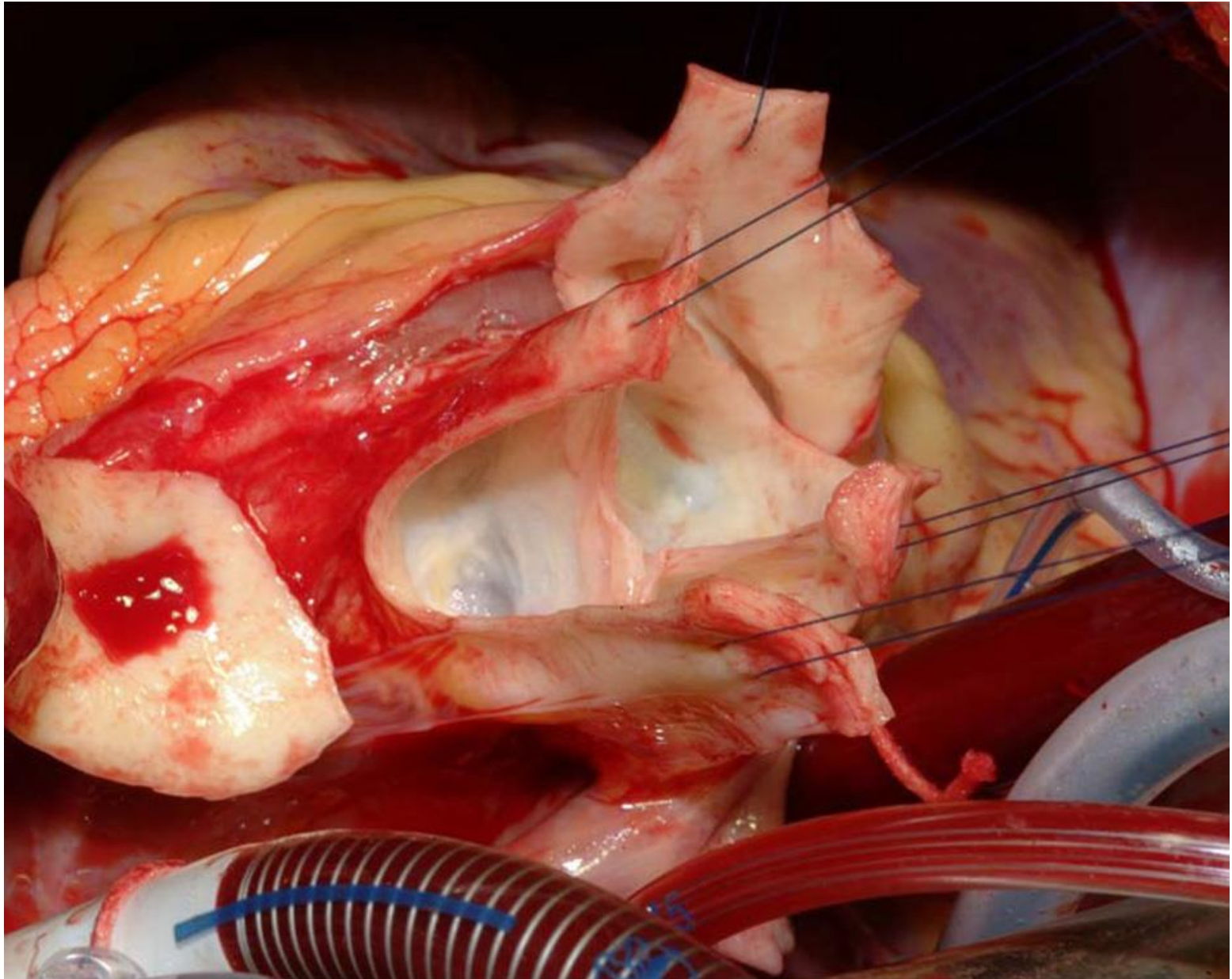
(David Procedure)



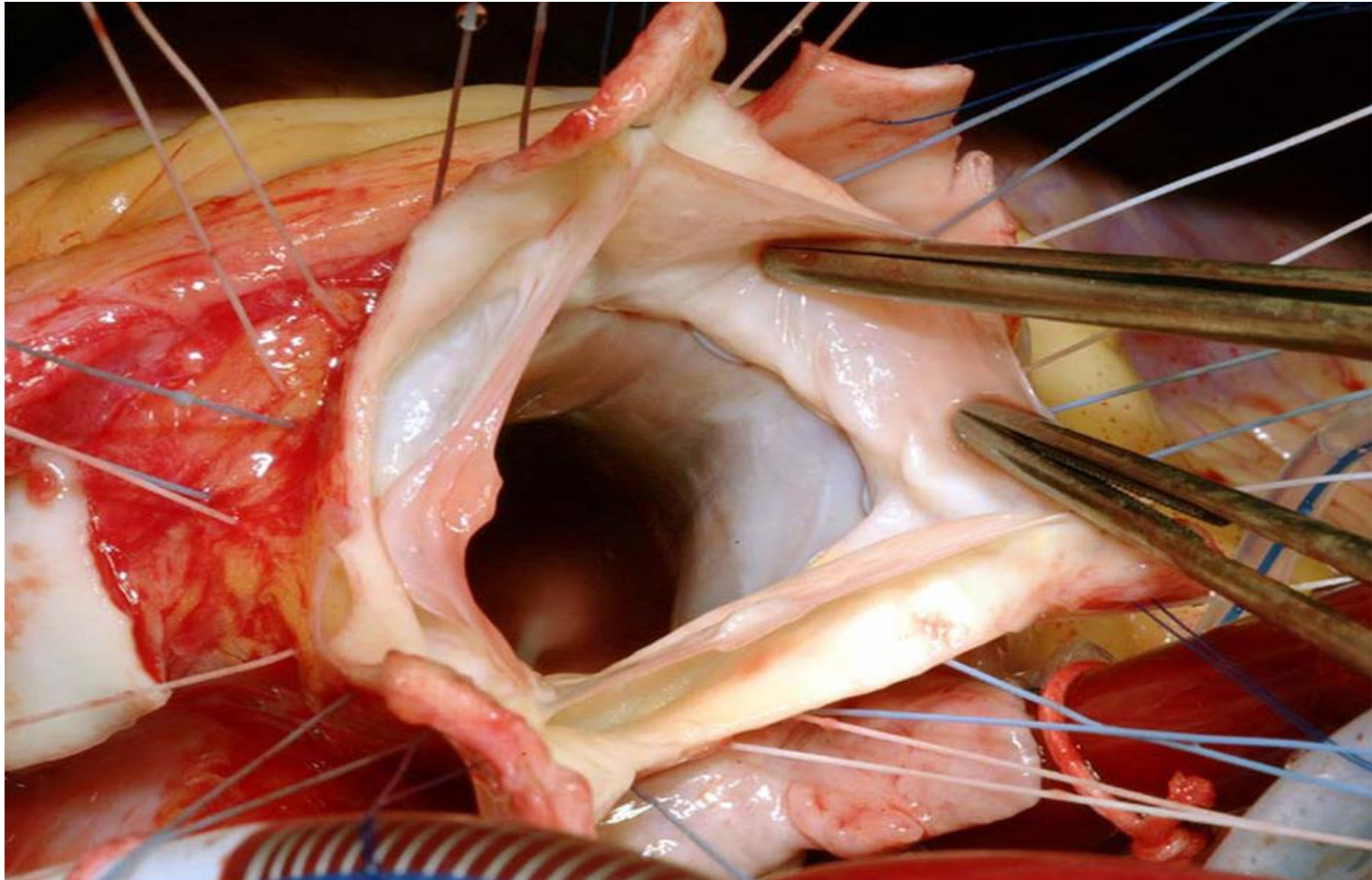
Resection of Aorta und Excision of Coronaries



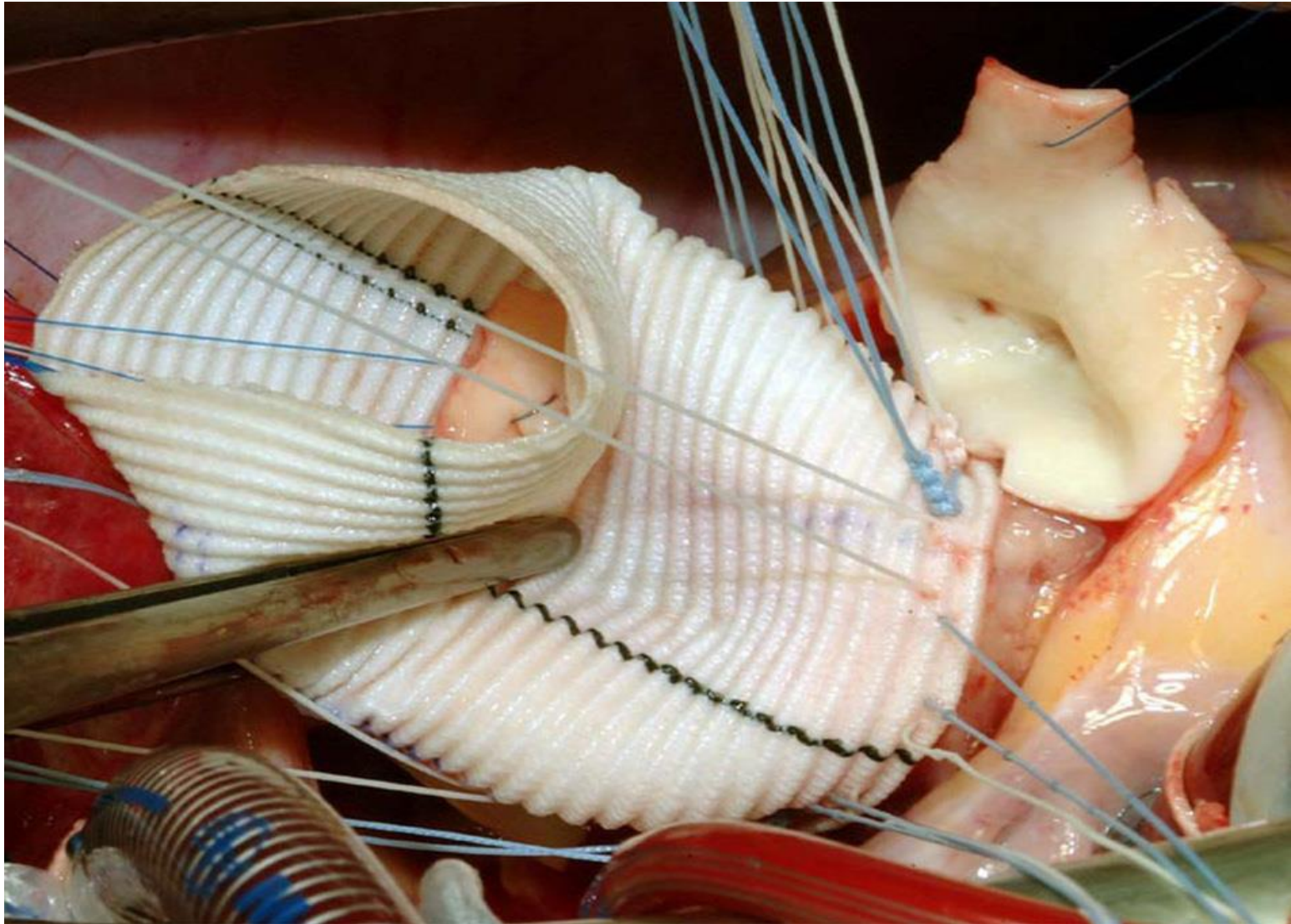
Resuspension of Commissures



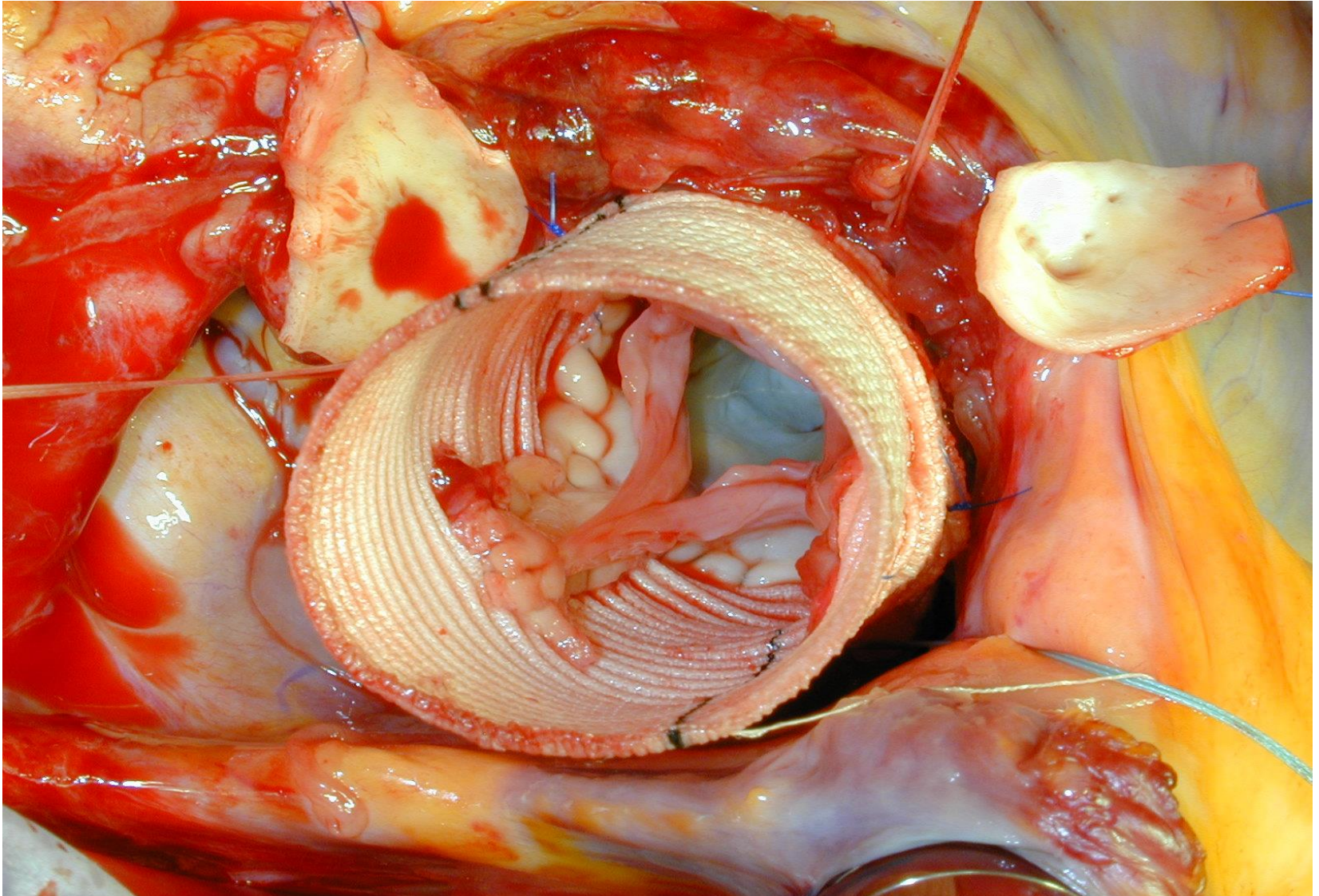
Placement of Annular Stiches below Cusps



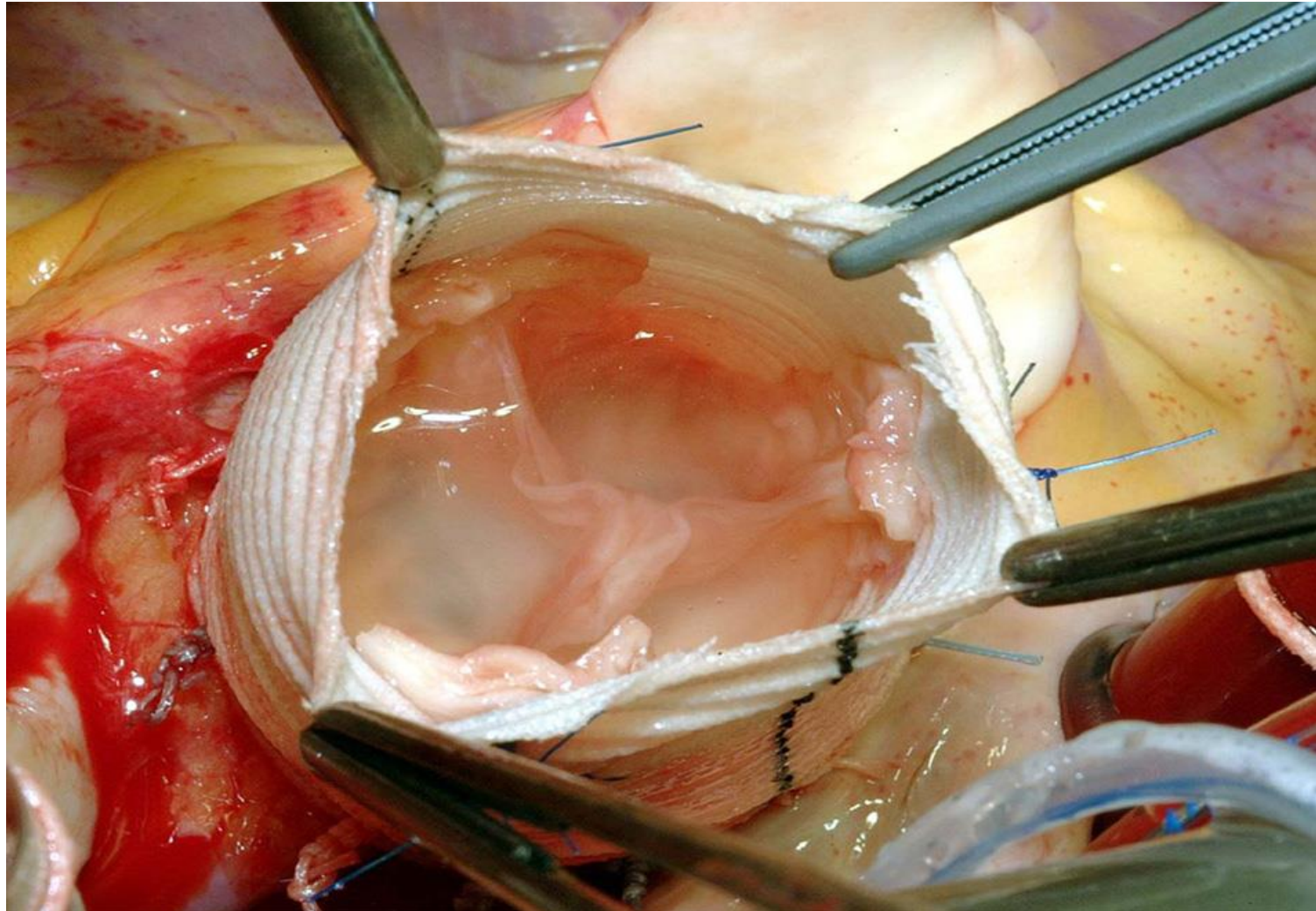
Tying Down the Graft to the Base



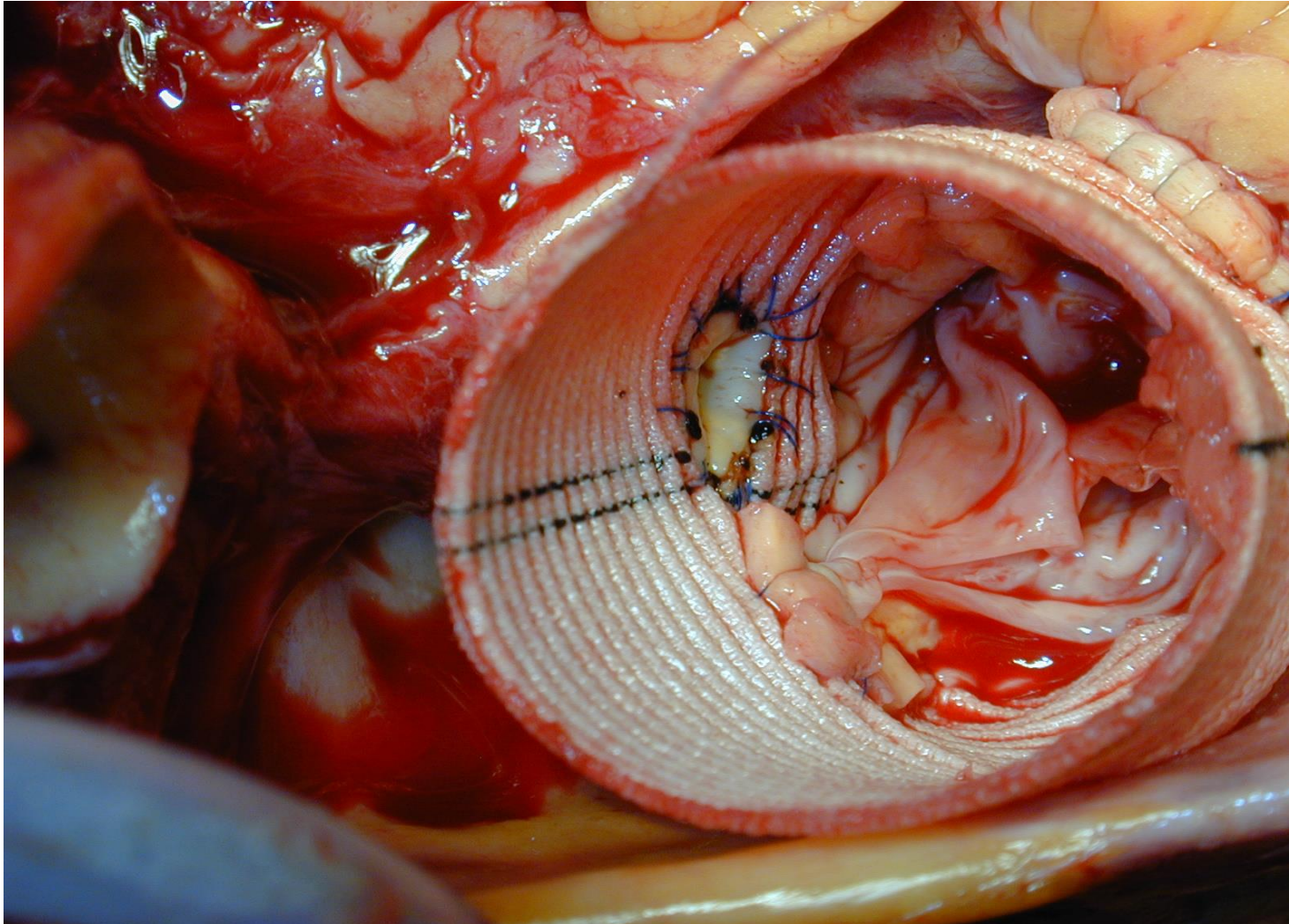
Sewing the Valve Into the Graft



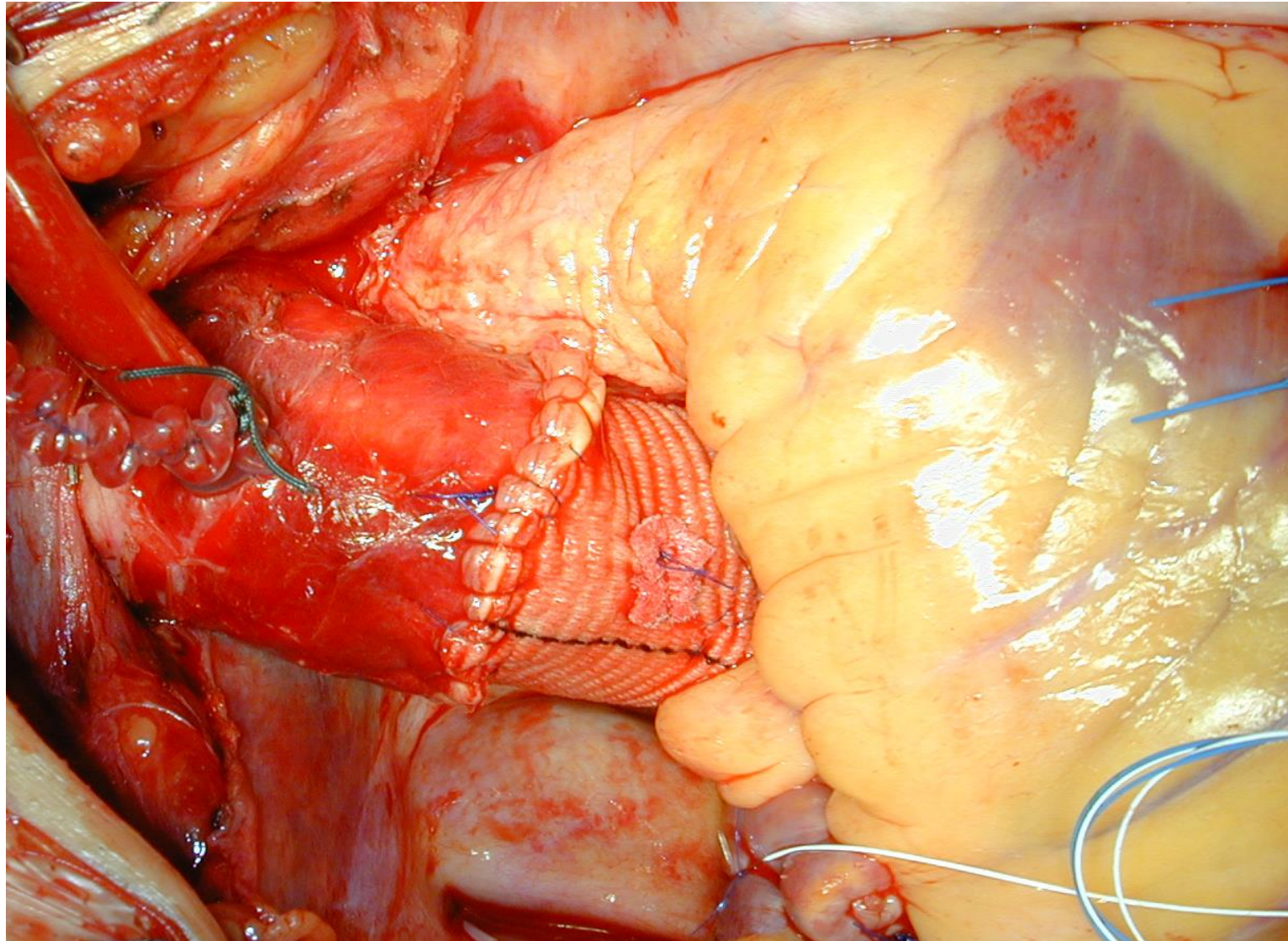
Interim Test of Function



Reimplantation of the Coronary Buttons

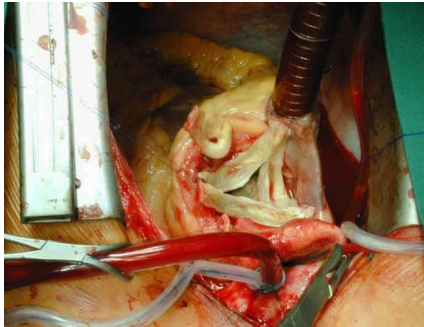


Completed Distal Anastomosis Graft-Aorta

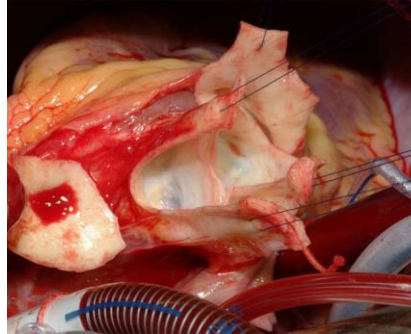


Things to watch for/think about doing a David

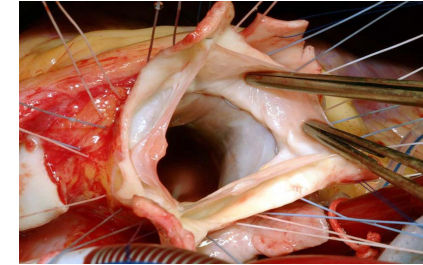
Resection of Aorta und Excision of Coronaries



Resuspension of Commissures



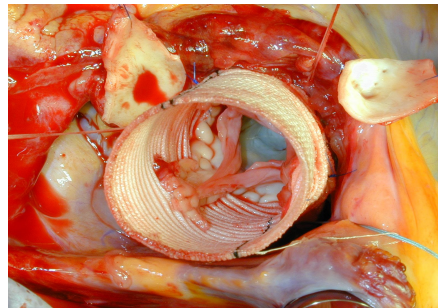
Placement of Annular Stiches below Cusps



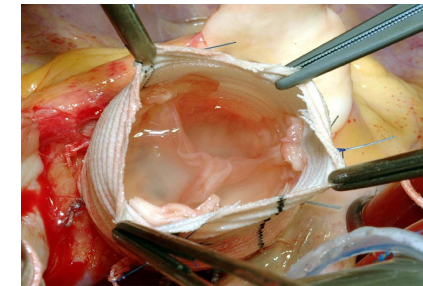
Tying Down the Graft to the Base



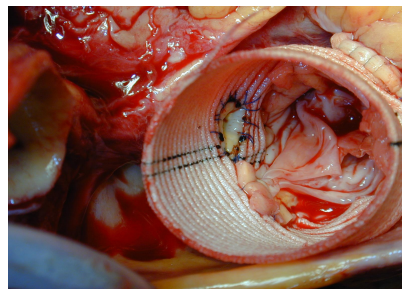
Sewing the Valve Into the Graft



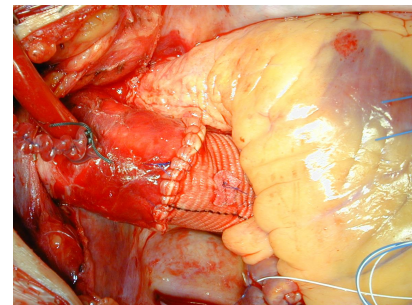
Interim Test of Function



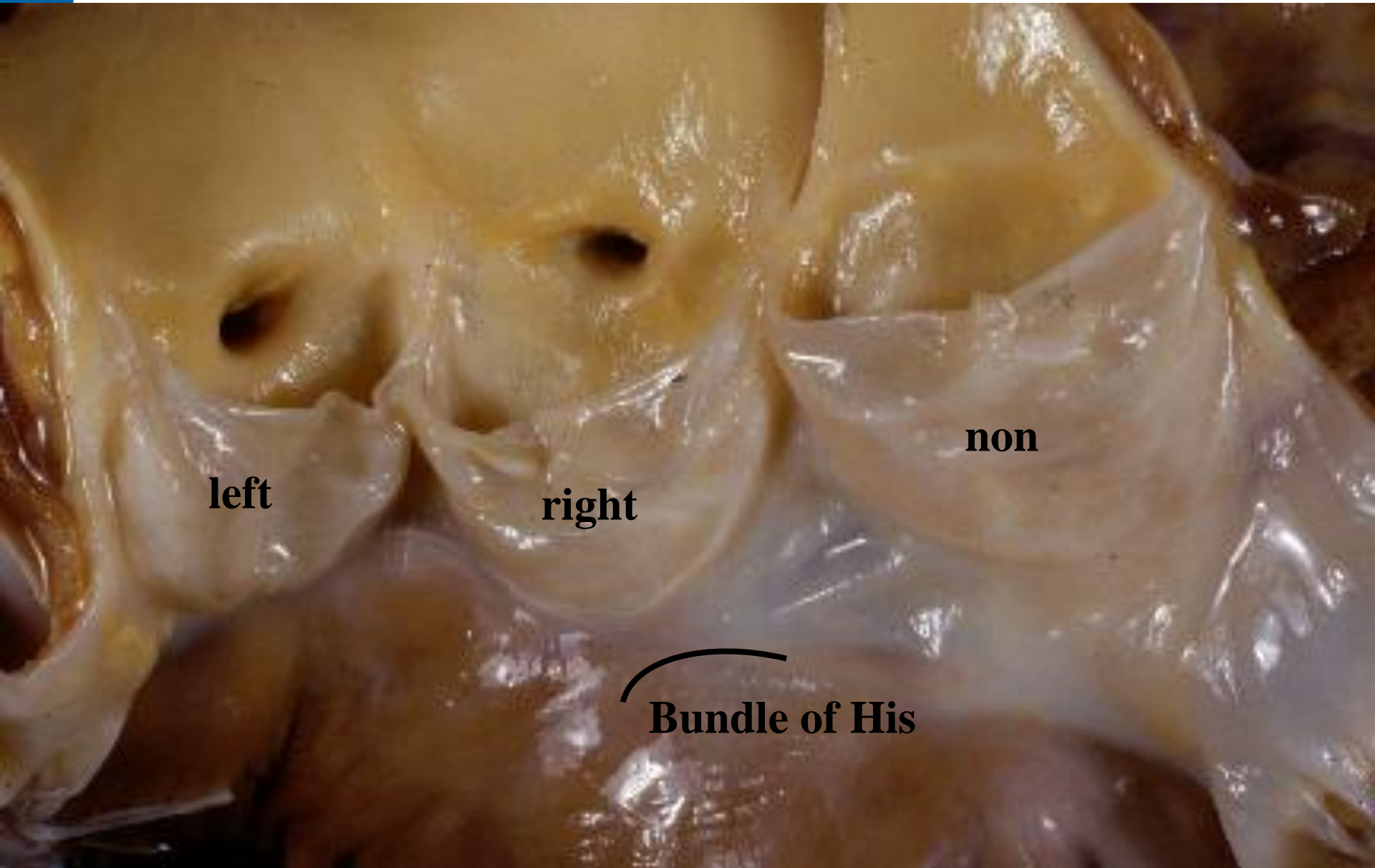
Reimplantation of the Coronary Buttons



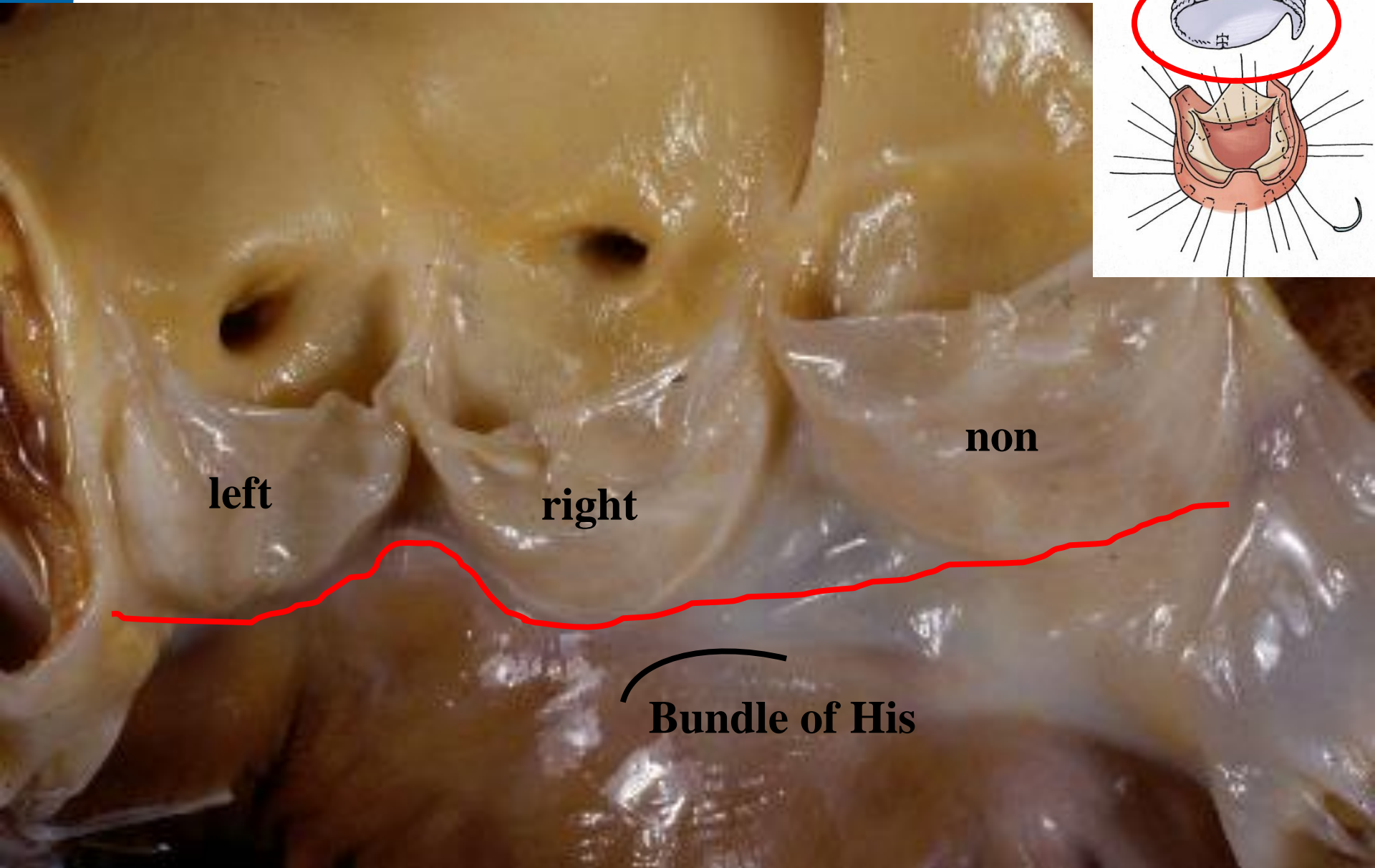
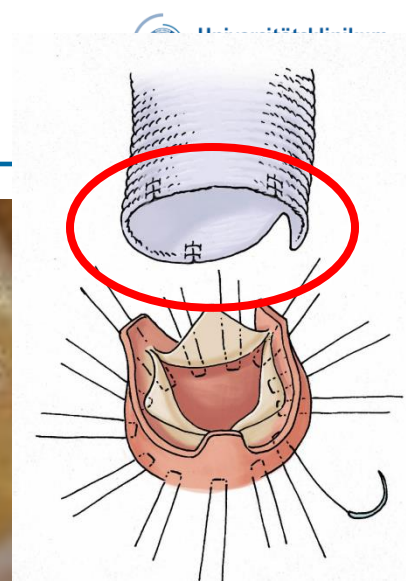
Completed Distal Anastomosis Graft-Aorta



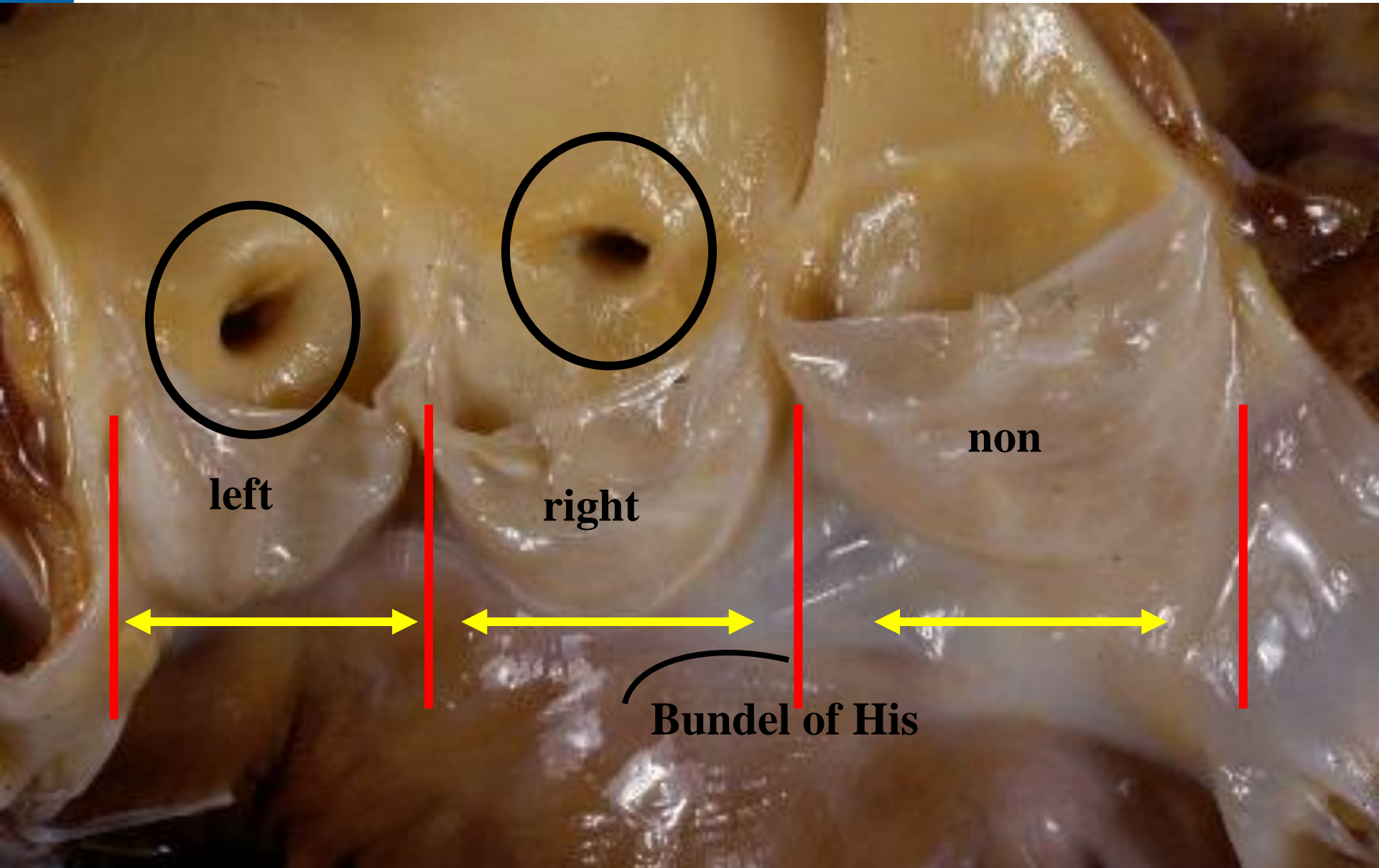
Root cut open



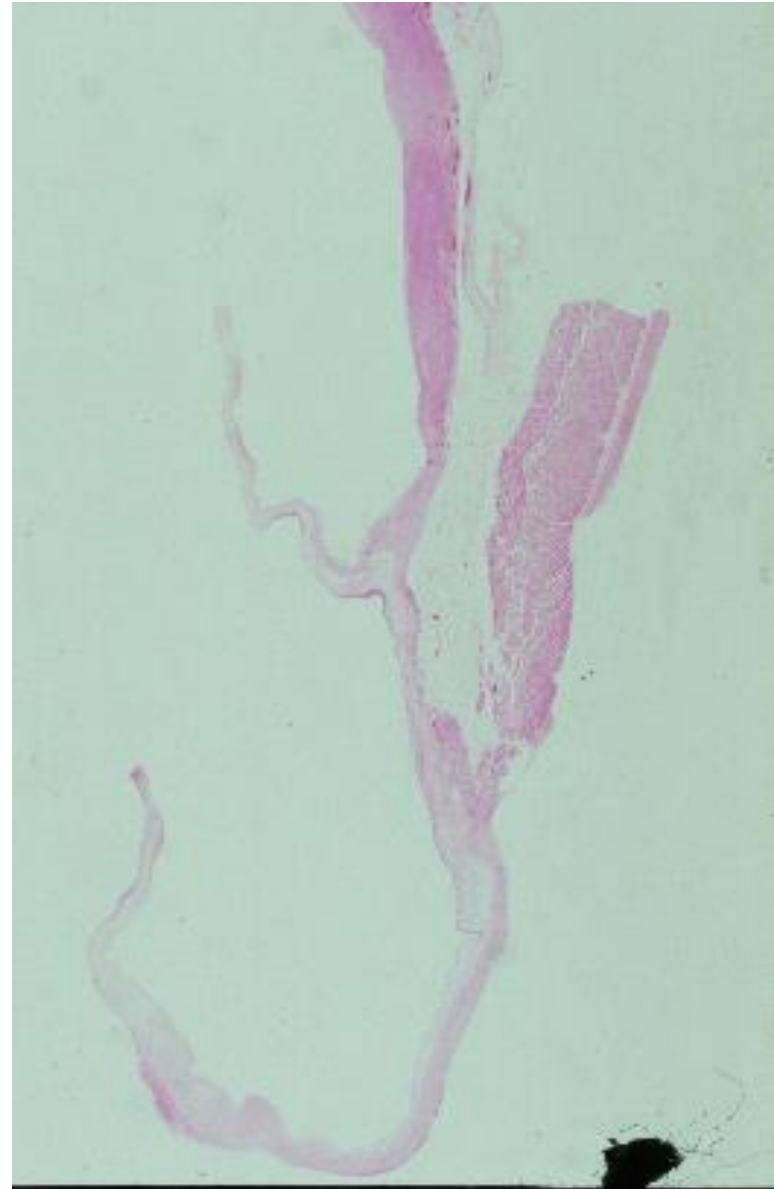
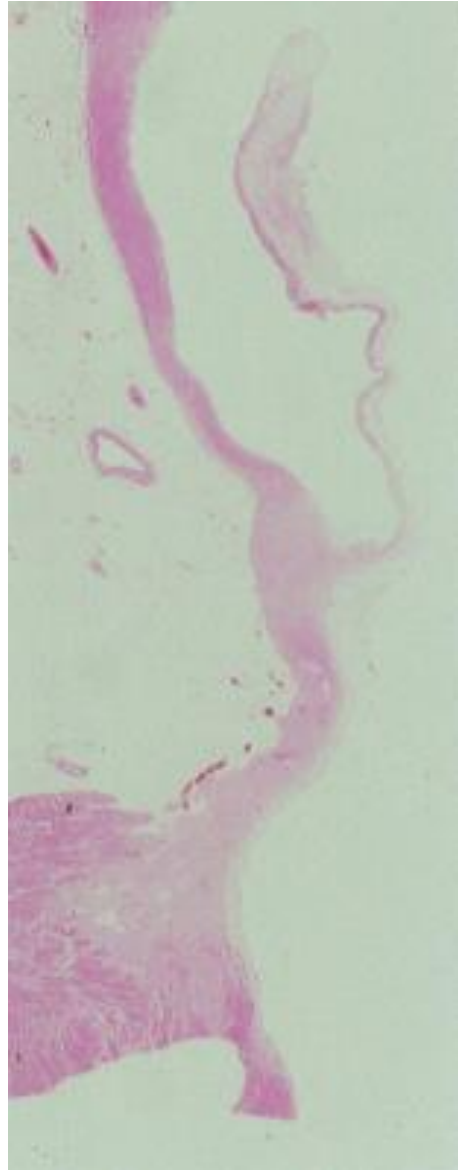
Adapting the Graft to Anatomy



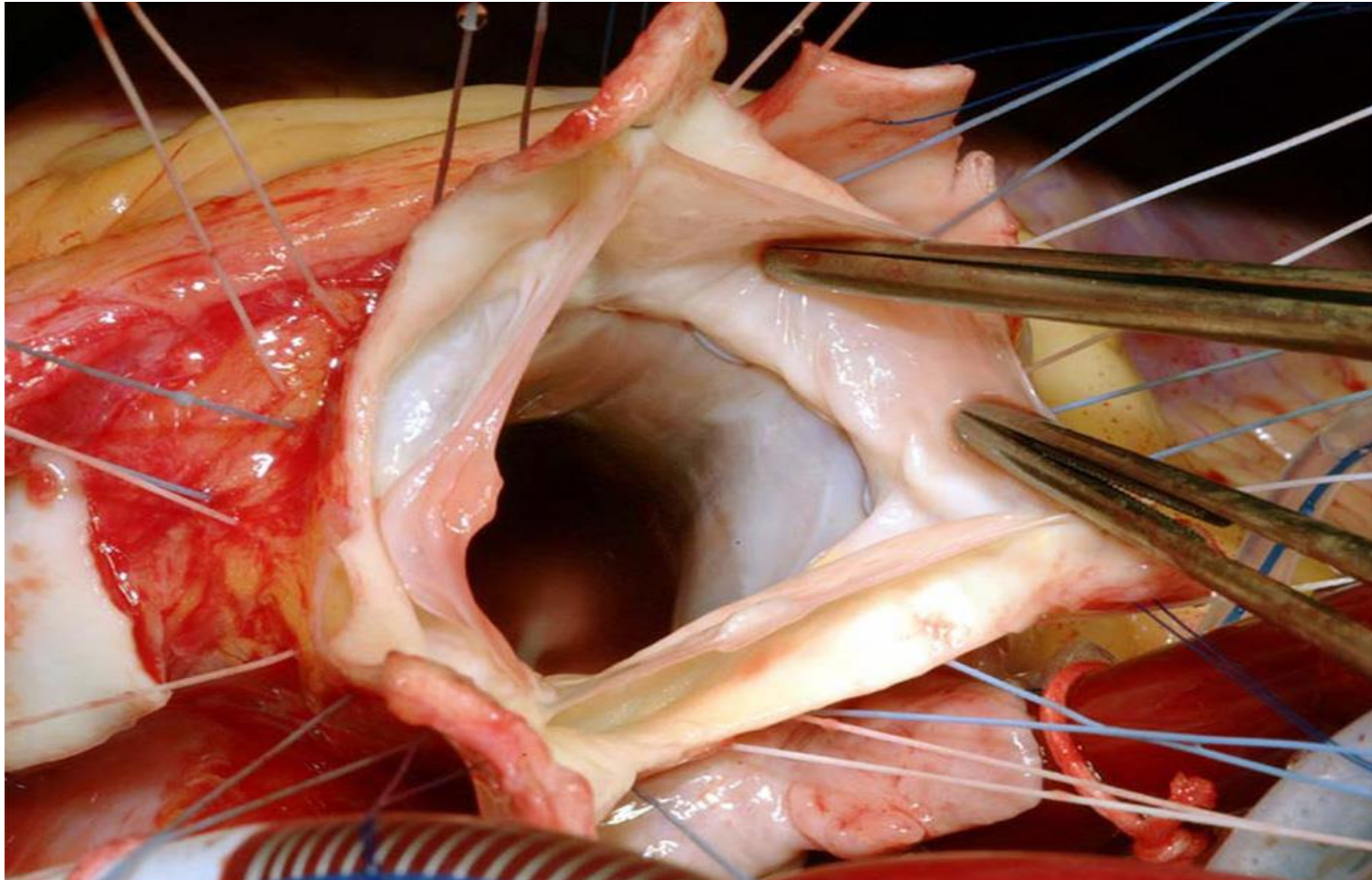
Real Life is Not Always Symmetrical



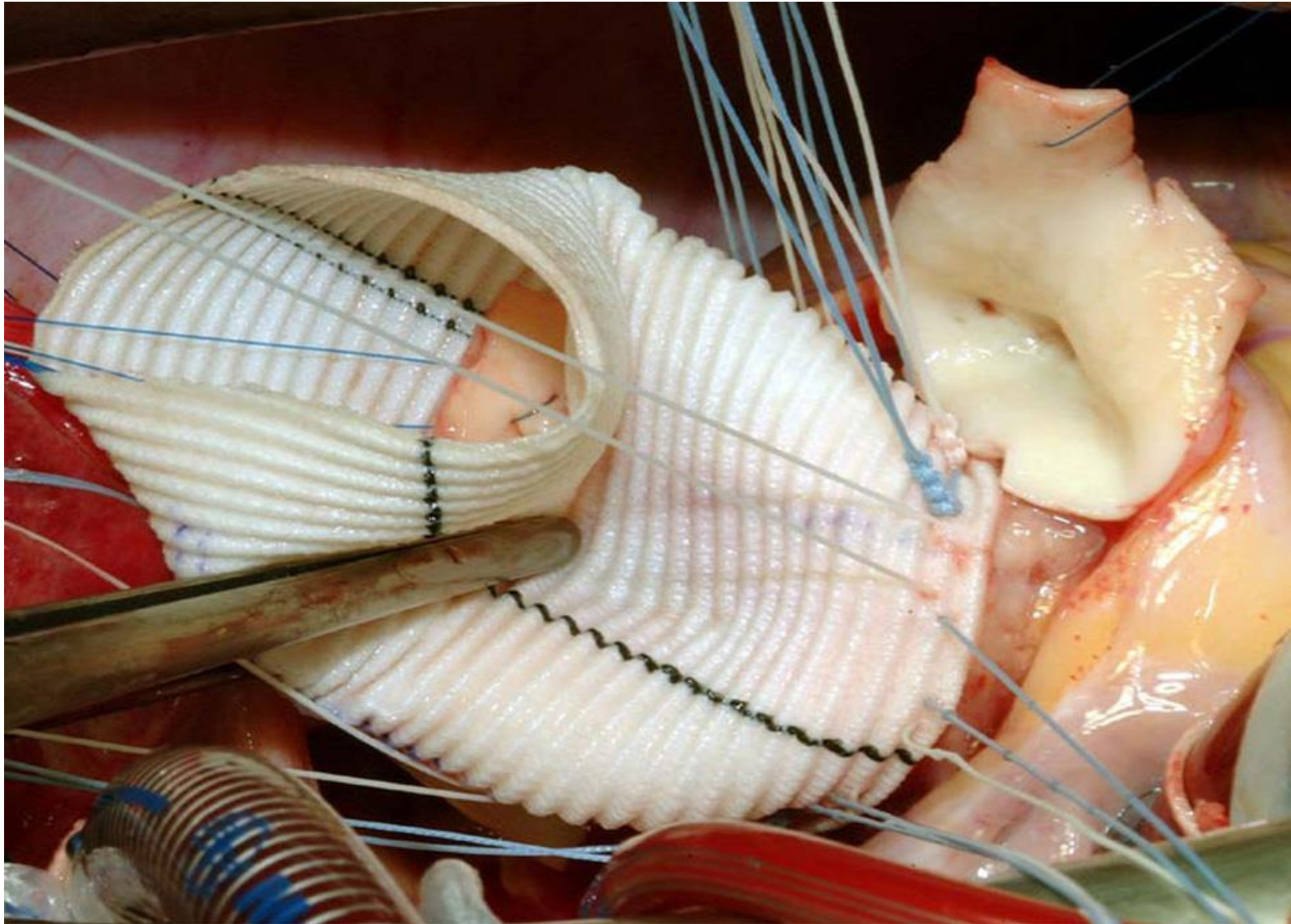
Where is the Aortic Annulus



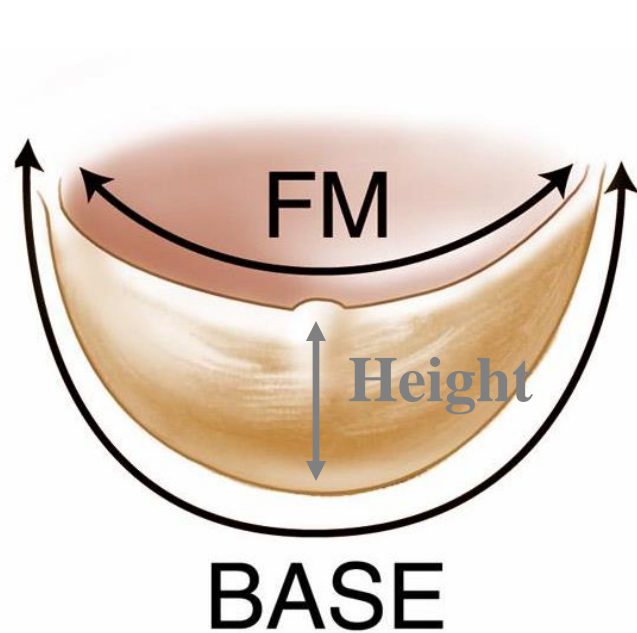
Think about Pledged Sutures for Base



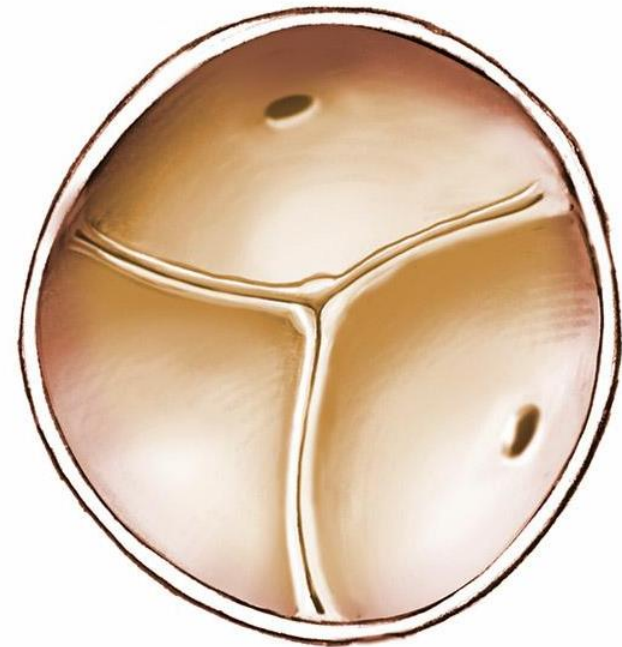
Graft Size Selection



Aortic Cusps

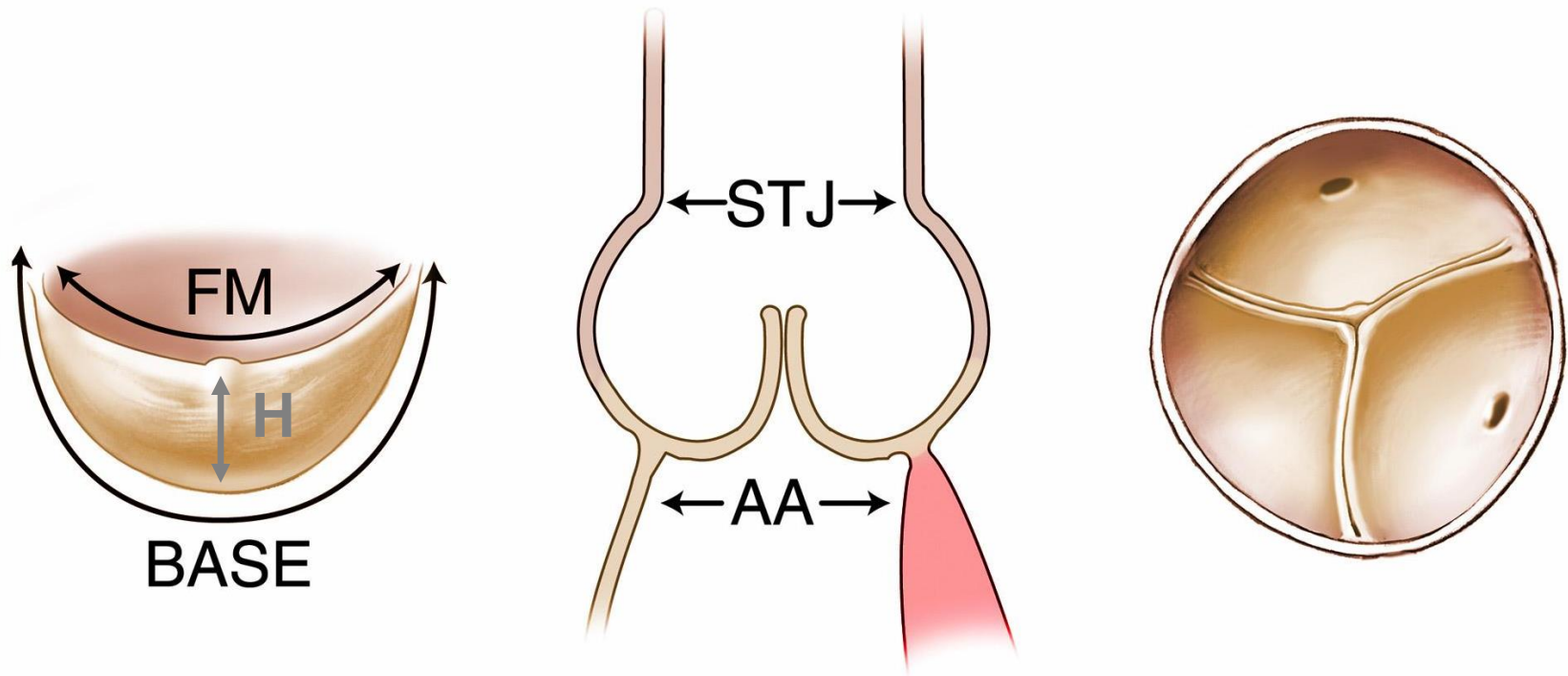


$$\text{Base} = 1.5 \text{ FM}$$



$$\text{Perimeter} = \pi \cdot \text{diameter}$$

Aortic Root: Geometric Relationships



Assumptions: $FM > AA$ or STJ
 $H > 0.5 AA$ or $0.5 STJ$

Graft Size Selection

From the original paper:

$$d = [(h_{\text{leaflet}} \times 2) \times 0.67] + (2A_{\text{owall}})$$

Graft Size Selection

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$$d = [(h_{\text{leaflet}} \times 2) \times 0.67] + (2A_{\text{owall}})$$

From „the horses mouth“:

Men: 30mm

Women: 28 mm

Graft Size Selection

From the original paper:

$$d = [(h_{\text{leaflet}} \times 2) \times 0.67] + (2A_{\text{owall}})$$

From „the horses mouth“:

„Eyeballing unscientific“

Men: 30mm

Women: 28 mm



+



Graft Size Selection

From the original paper:

$$d = [(h_{\text{leaflet}} \times 2) \times 0.67] + (2A_{\text{owall}})$$

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+



+



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Men: 30mm

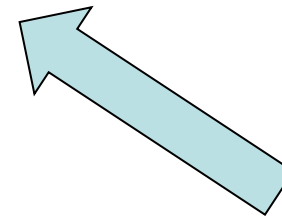
Women: 28 mm



+



+



Graft Size Selection

From the original paper:

$$d = [(h_{\text{leaflet}} \times 2) \times 0.67] + (2A_{\text{owall}})$$

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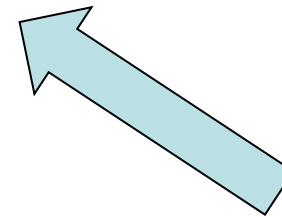
Women: 28 mm



+



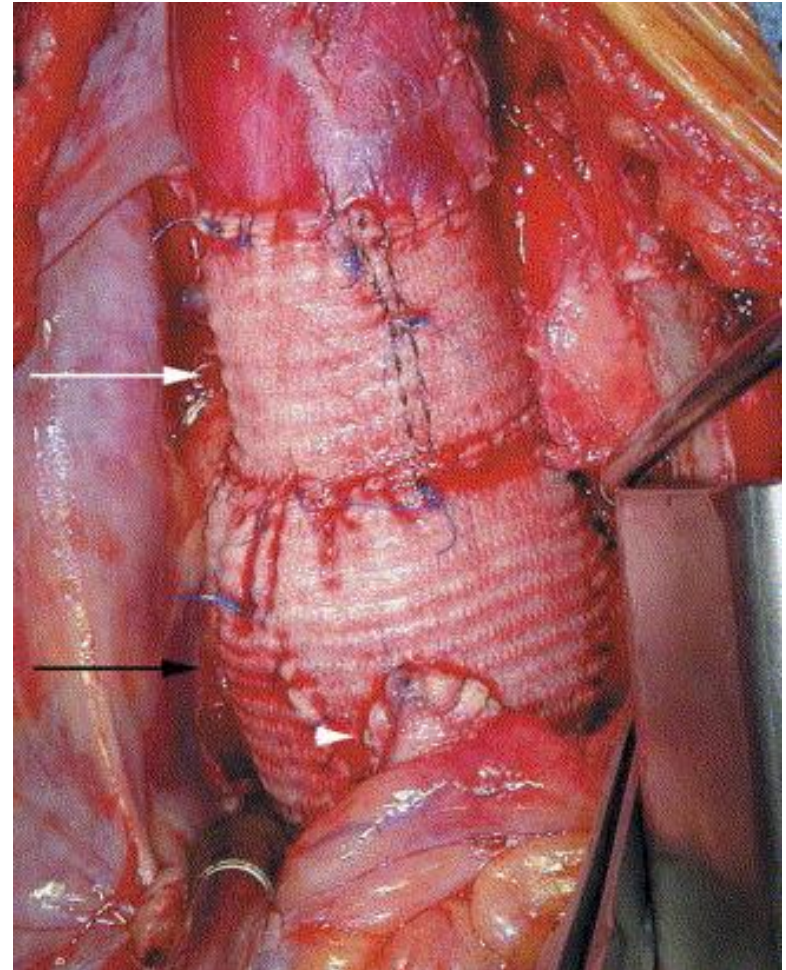
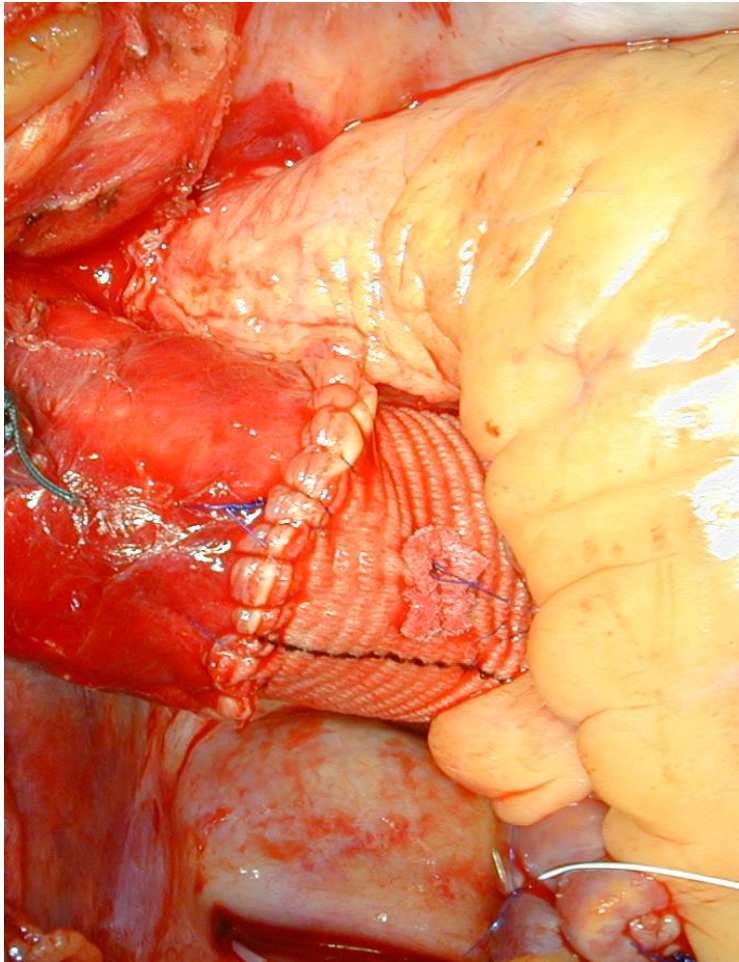
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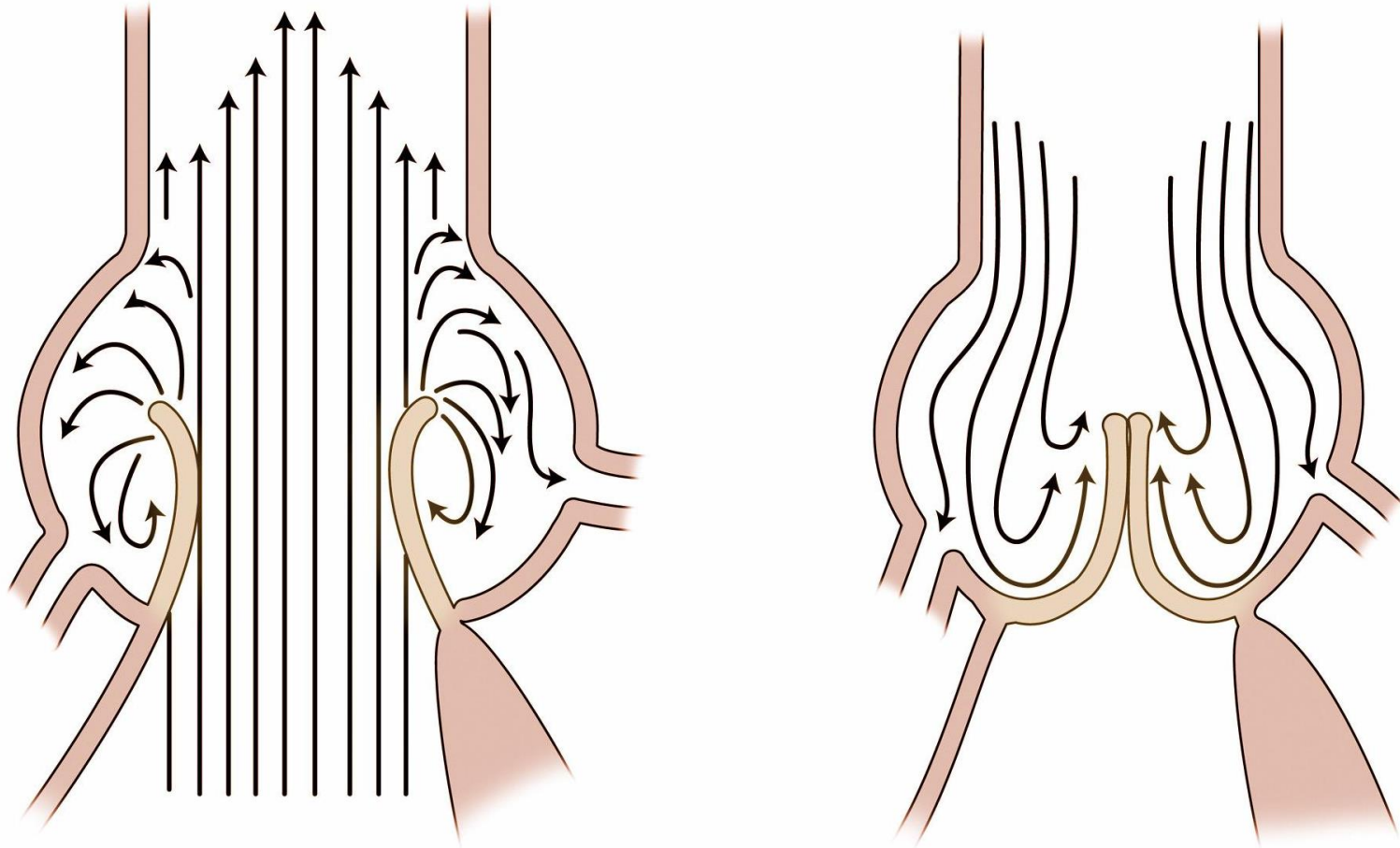
Average Graft Size (in 25years and 78%men): 31+4mm

TDavid I through V

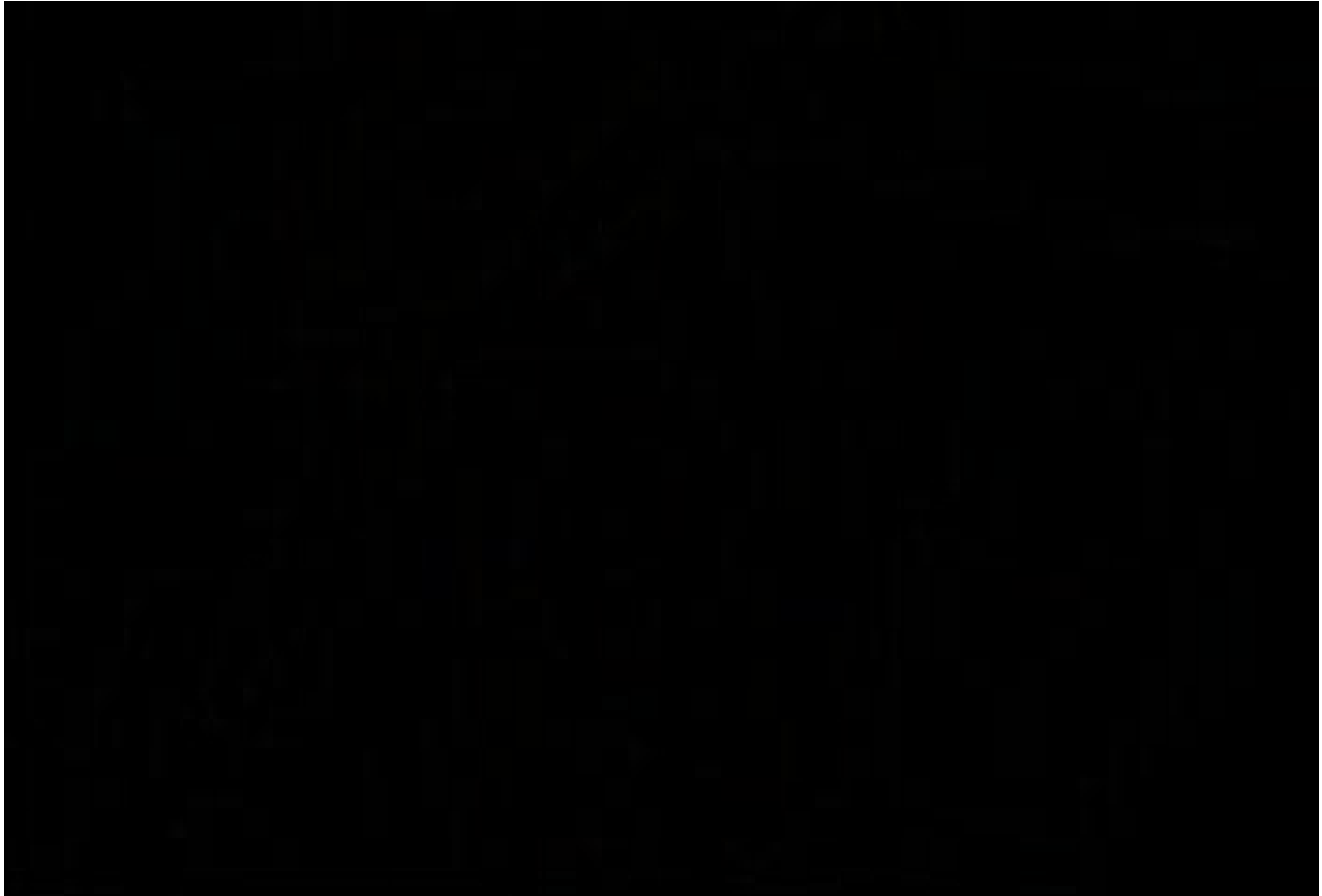
Straight Tube vs. Neo-Sinuses



Why do we have Sinuses of Valsalva ?



Tirone David Valve Sparing Procedure

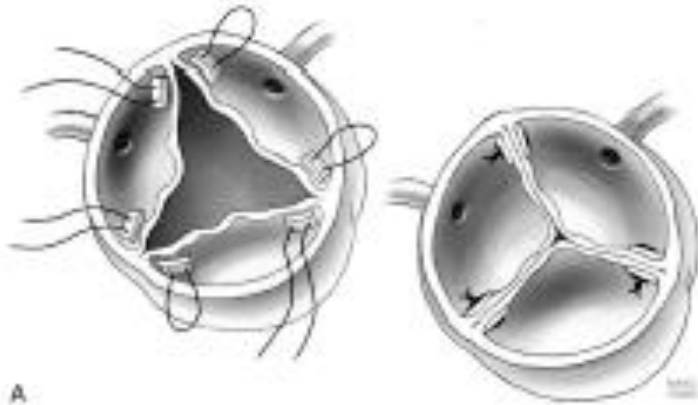


Straight Tube vs. Neo-Sinuses

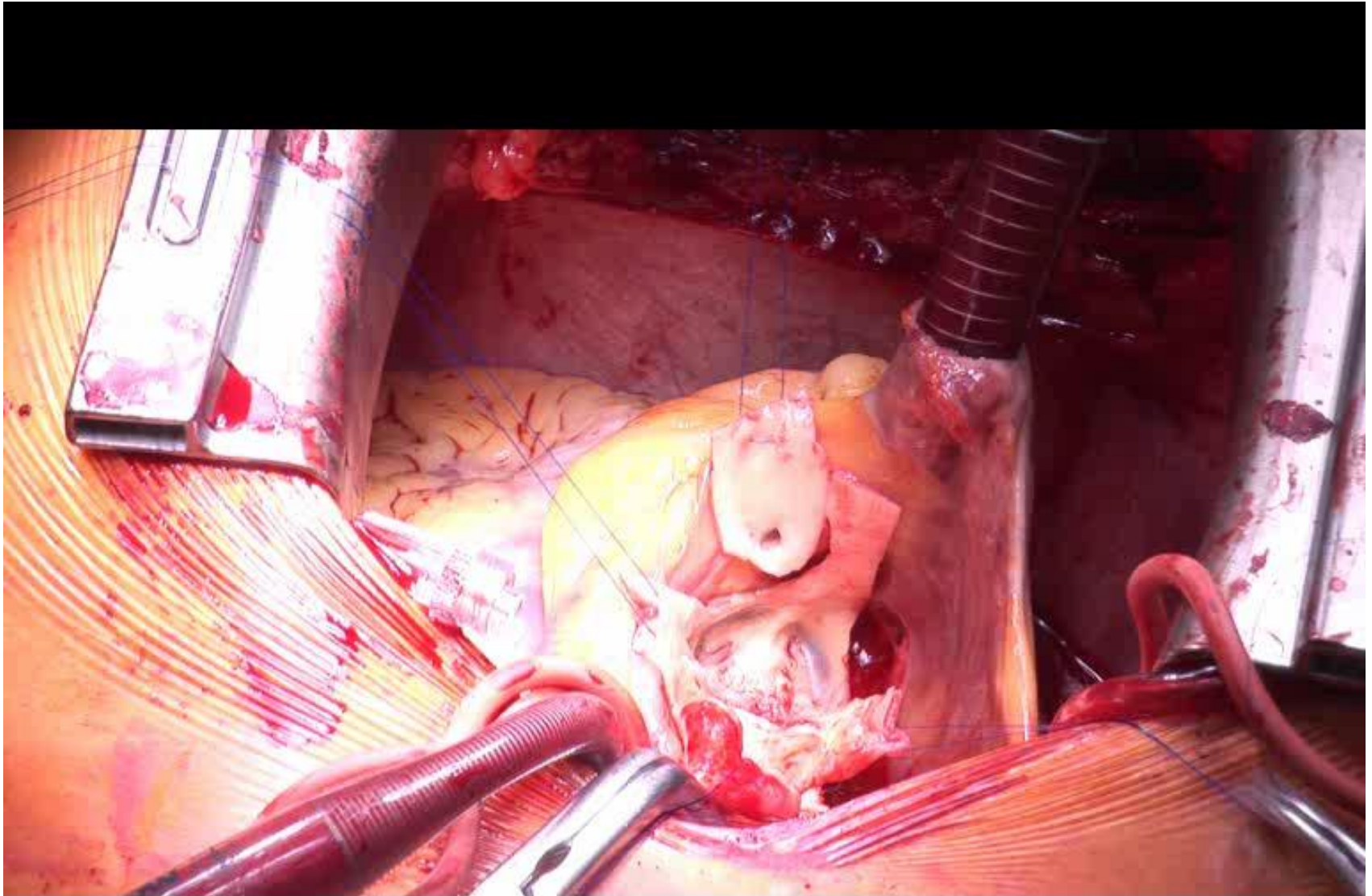
Are there differences in outcome?

?

What if cusps prolapse or are fenestrated?



Reimplantation and Cusp Repair for Bicuspid AV



One last thought – think about a possible reoperation

Do we have to touch the root ?

- **Re-Root Replacement carries higher risk**

Graft size selection determines prosthetic size on reoperation

- **Know the outer diameters of your prosthetic valves**

Outcomes and Durability



AVR Does Not Normalize Life Expectancy

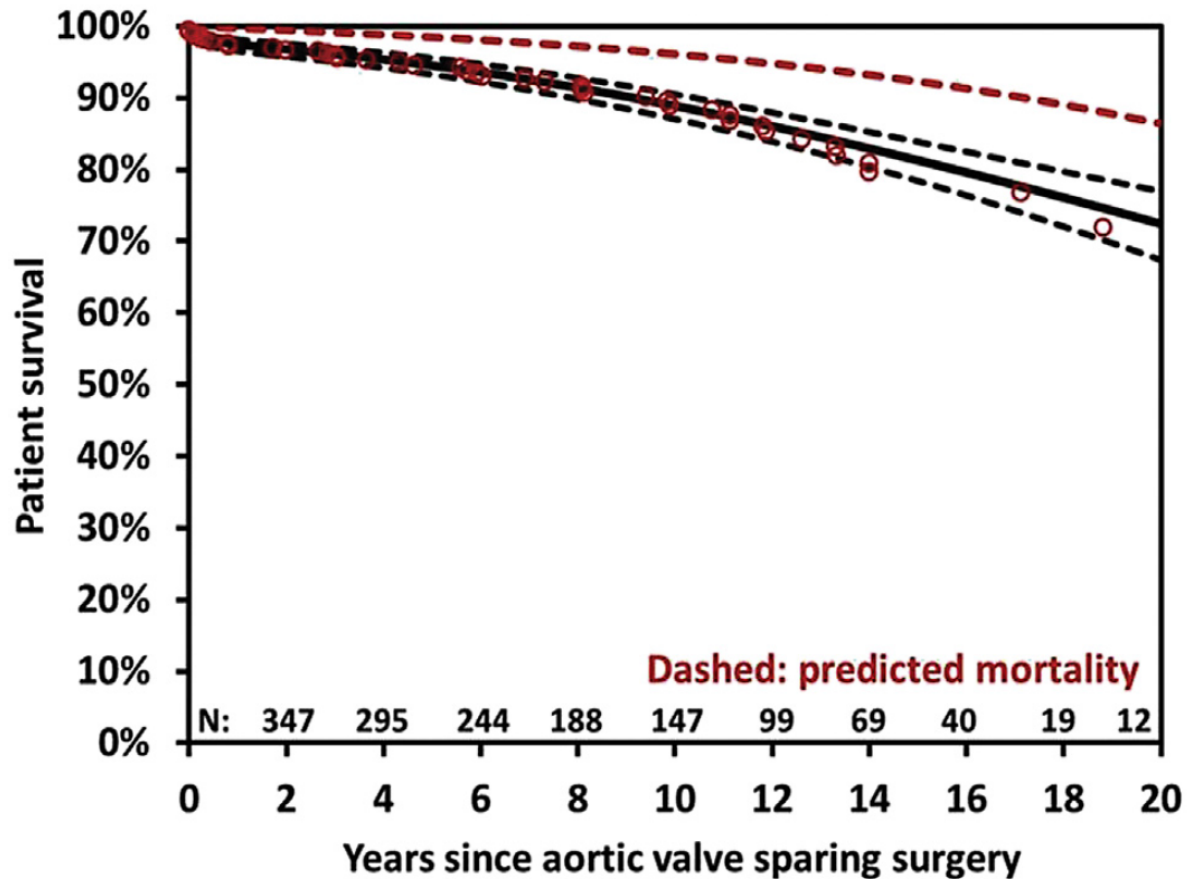
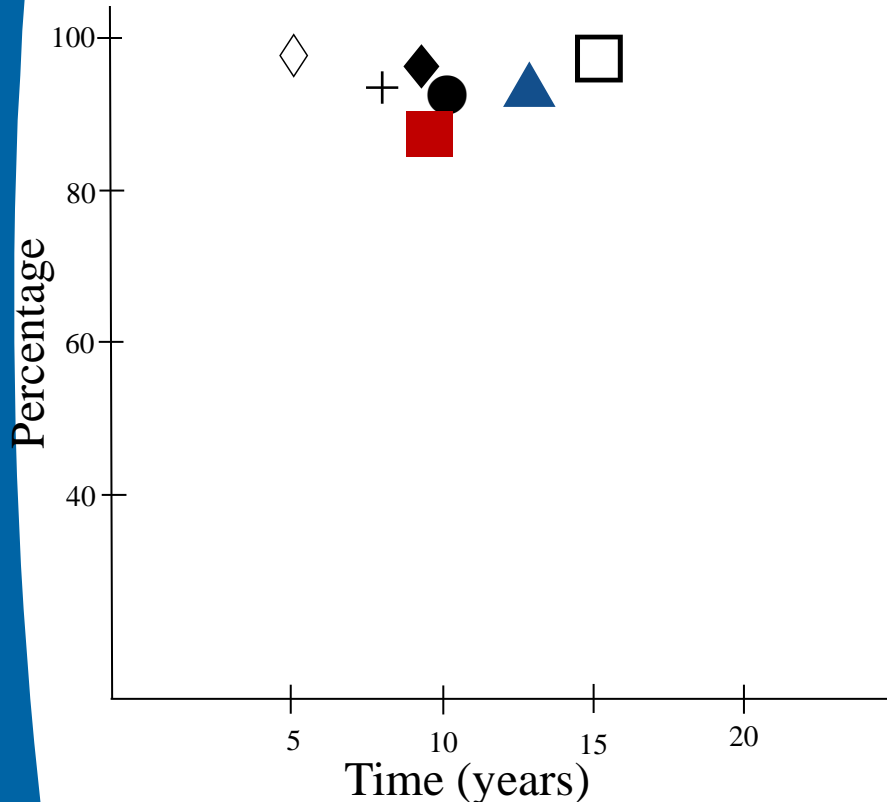


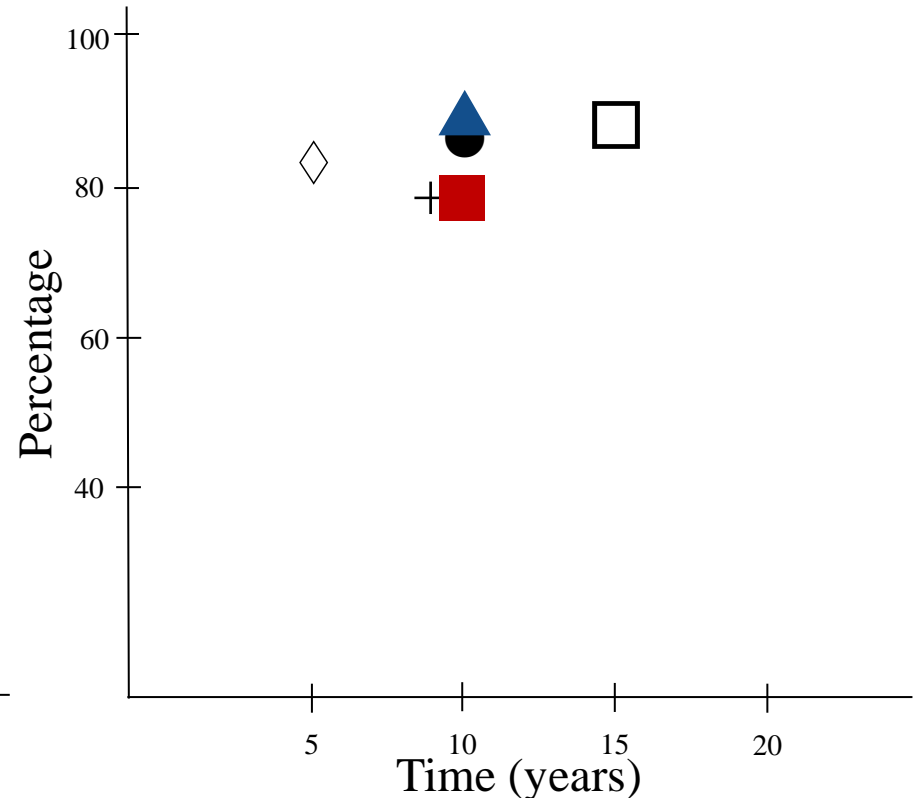
FIGURE 1. Patient survival compared with the general population and matched for age and gender.

Excellent Long Term Durability (David-Operation)

Freedom from Re-Operation



Freedom from moderate to severe AR



- = David et al. JTCVS 2013 (n=296)
- + = de Kerchove et al. EJCTS 2015 (n=154)
- = Shrestha et al. EJCTS 2012 (n=126(76))
- = Schaefer et al. JTCVS 2012 (n = 29)
- ▲ = Jena (n=125)

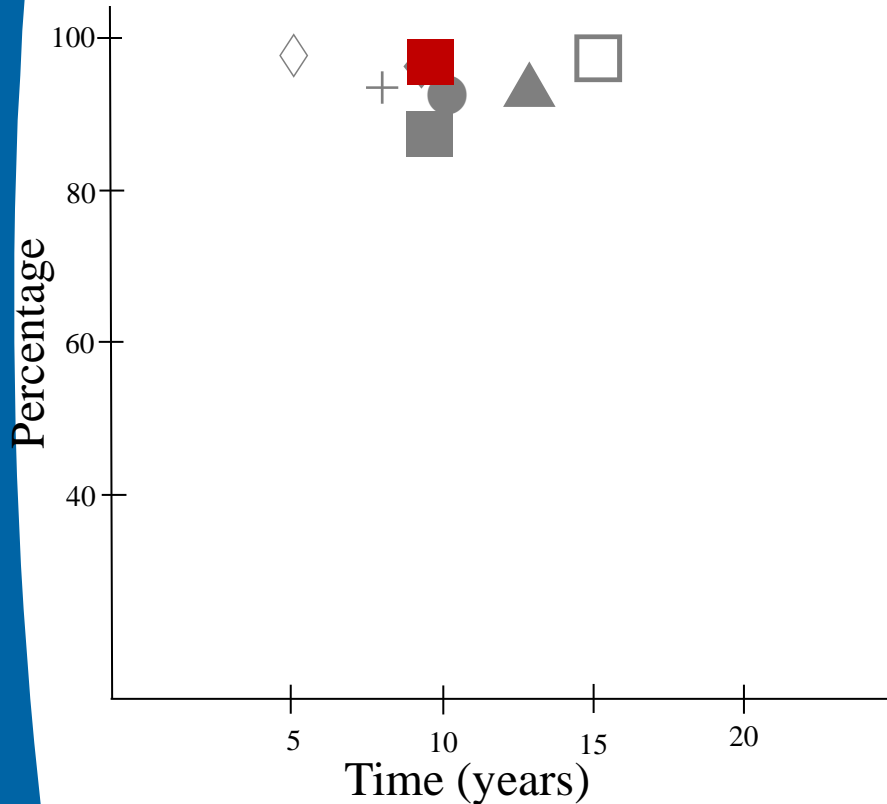
- ◆ = Miller et al. JTCVS 2013 (n = 233)
- ◇ = Stephens et al. JTCVS 2014 (n=154)

Summary of Reported “David” Outcomes

Authors		N	Mean Age	Survival	FF Re-OP	FF AR \geq II
David et al.	Reimplantation	296	46	15y: 80%	15y: 97%	15y: 89%
	Remodelling	75	51	15y: 80%	15y: 90%	15y: 84%
De Kerchove et al.	Reimplantation	154	53	8y: 80%	8y: 92%	8y: 71%
	Remodelling	n.a.	n.a.	n.a.	n.a.	n.a.
Shrestha et al.	Reimplantation	126 (76)	57	10y: 70%	10y: 87%	10y: 89%
	Remodelling	n.a.	n.a.	n.a.	n.a.	n.a.
Miller et al.	Reimplantation	233	43	10y: 93%	10y: 92%	n.a.
	Remodelling	n.a.	n.a.	n.a.	n.a.	n.a.
Stephens et al.	Reimplantation	154	38	n.a.	5y: 96%	5y: 85%
	Remodelling	n.a.	n.a.	n.a.	n.a.	n.a.
Schaefers et al.	Reimplantation	29	57	10y: 83%	10y: 80%	10y: 76%
	Remodelling	401	57	10y: 83%	10y: 92%	10y: 67%
Jena	Reimplantation	125	59	12y: 85%	12y: 89%	12y: 88%
	Remodelling	n.a.	n.a.	n.a.	n.a.	n.a.

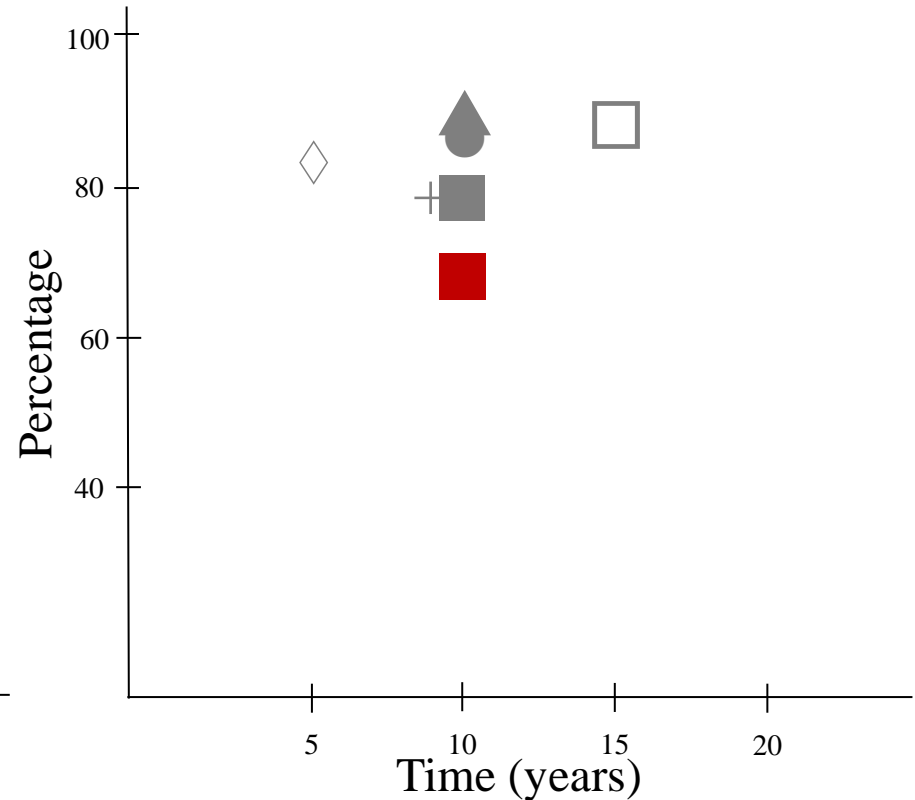
Comparison to Remodelling

Freedom from Re-Operation



- = David et al. JTCVS 2013 (n=296)
- + = de Kerchove et al. EJCTS 2015 (n=154)
- = Shrestha et al. EJCTS 2012 (n=126(76))
- = Schrefers et al. JTCVS 2012 (n = 29)
- ▲ = Jena (n=125)

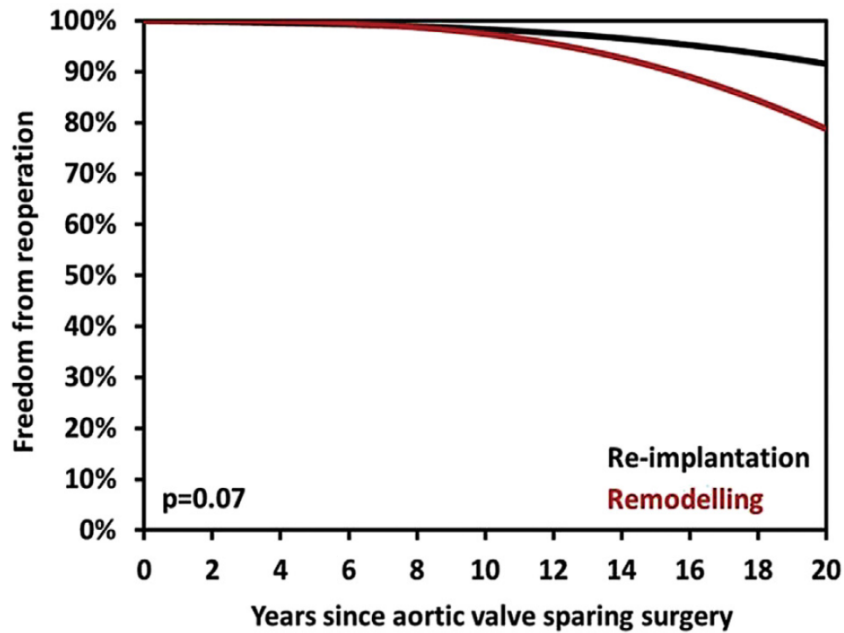
Freedom from moderate to severe AR



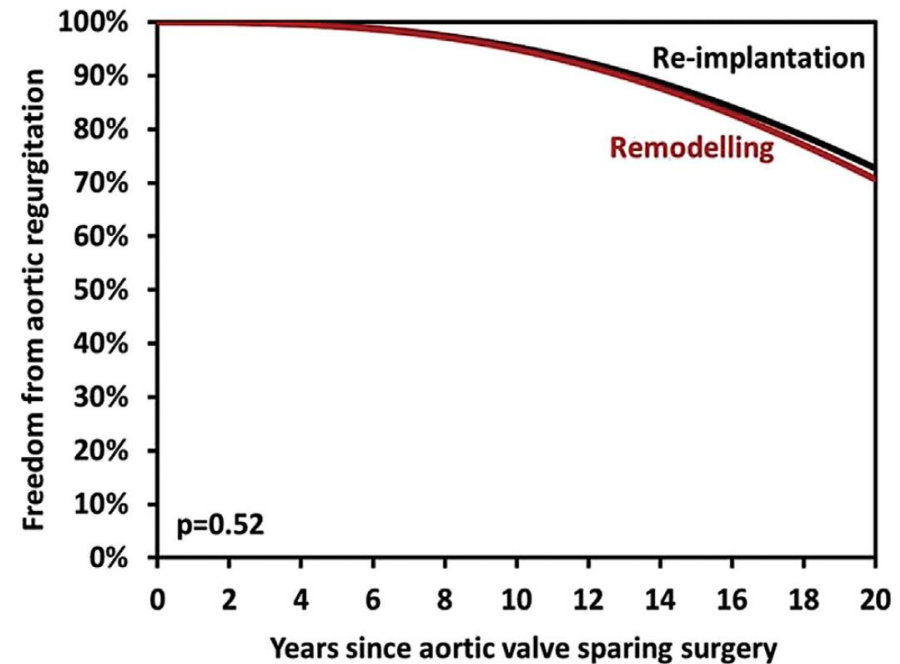
- ◆ = Miller et al. JTCVS 2013 (n = 233)
- ◇ = Stephens et al. JTCVS 2014 (n=154)
- = Schrefers et al. JTCVS 2012 (n=401 remodel.)

Re-Implantation vs. Remodelling

Freedom from Re-Operation



Freedom from AR > I



Comparison David vs. Yacoub Metaanalysis

Aortic valve sparing operations in aortic root aneurysms: remodeling or reimplantation?

David Tian, Mohammad Rahnavardi, Tristan D. Yan

392 papers were found using the reported search criteria.

14 papers with best information comparing the two valve-sparing techniques.

No randomised controlled trials (RCT) or meta-analyses were found.

A total of 1,338 patients from 13 centres were included in this study.

Operative technique was Yacoub for 606 patients and David for 732 patients

The results from the present analysis demonstrate comparable outcomes for both techniques. However, there is a tendency for less freedom from significant long-term AI in the Yacoub group than the David group, which does not necessarily result in a higher reoperation rate in Yacoub group compared to the David group.

Comparison David vs. Yacoub Metaanalysis

Aortic valve sparing operations in aortic root aneurysms: remodeling or reimplantation?

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Similarly, pathologies that impair root integrity (such as MFS, acute type A aortic dissection, and excessive annular dilatation) may benefit from the David rather than the Yacoub technique to support the annulus.

Remodelling vs. Reimplantation - Differentiated

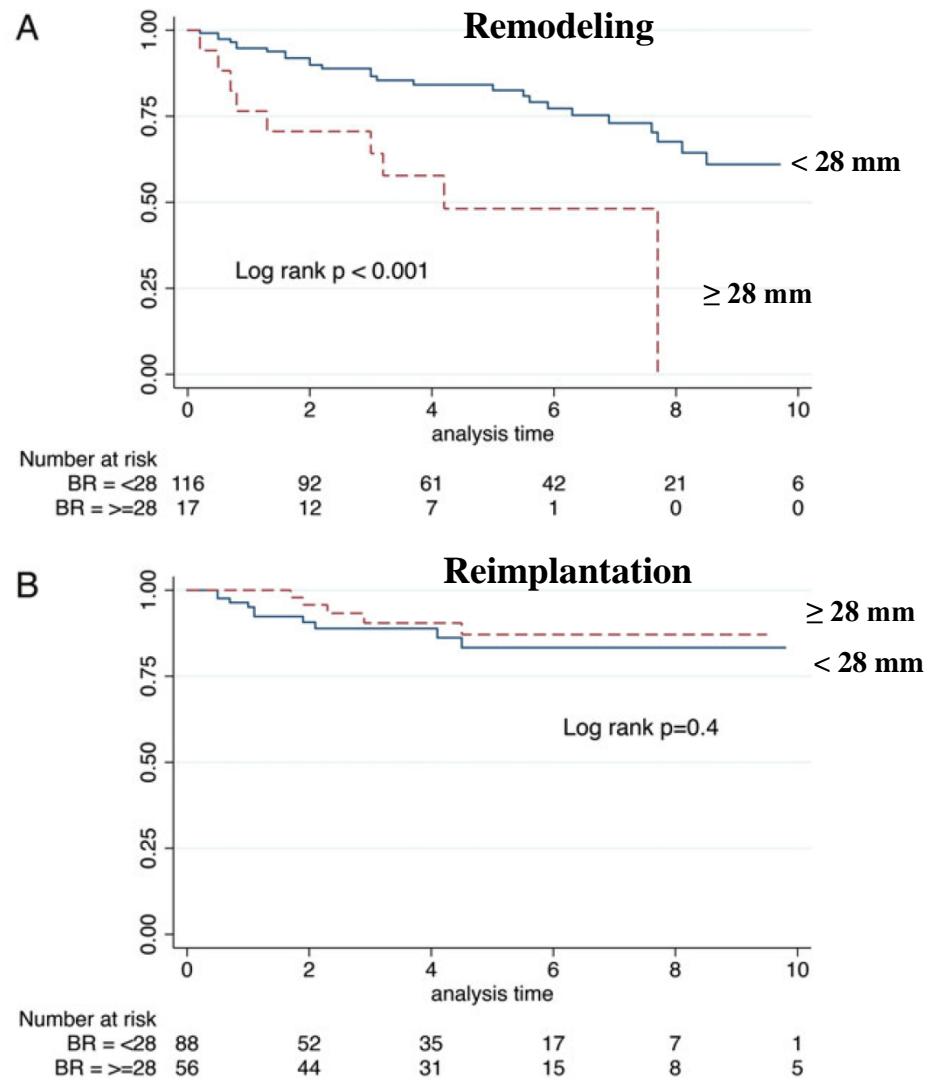


Figure 2: Freedom from recurrent AR >1+ in SCA group as a function of pre-operative BR diameter <28 mm (full line) or ≥28 mm (dotted line) (A); and in the VSR group (B). SCA: subcommissural annuloplasty; BR: basal ring; VSR: valve sparing reimplantation.

Aortic Valve Reimplantation is a reproducible and durable technique that yields excellent long-term results in patients with isolated aortic regurgitation and tricuspid valves

Results for bicuspid valve repair with this technique are comparable but depend mainly on patient selection.

Compared to the remodeling technique, reimplantation seems to have an advantage in patients with dilated annuli (>28mm).

For „Beginners“, the technique is „one safe way to Rome“.

Thank you for your Attention



Cardiac Surgery is „Thinking with your Hands“