Brussels' Live Surgery Course

Aortic Valve Repair

March 26th-27th, 2018 – Brussels, Belgium

Valve-Sparing Reimplantation in TAV & BAV

Department of Cardiothoracic and Vascular Surgery
Cliniques Universitaires St-Luc, IREC, UCL, Brussels, Belgium

Cliniques universitaires SAINT-LUC UCL BRUXELLES

UCL Université catholique de Louvain

AI Classification and Treatment Techniques

Brussels Algorithm in approaching Root Repair in patients with AI

Normal Root (<40 mm)

Dilated Root (≥40 mm)

Normal VAJ (<26 mm)

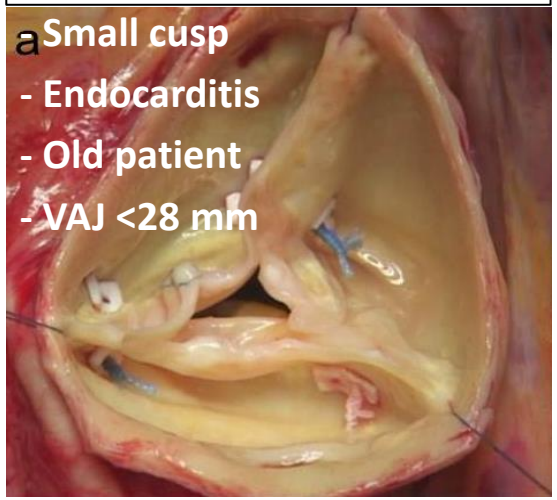
Large VAJ (>26 mm)

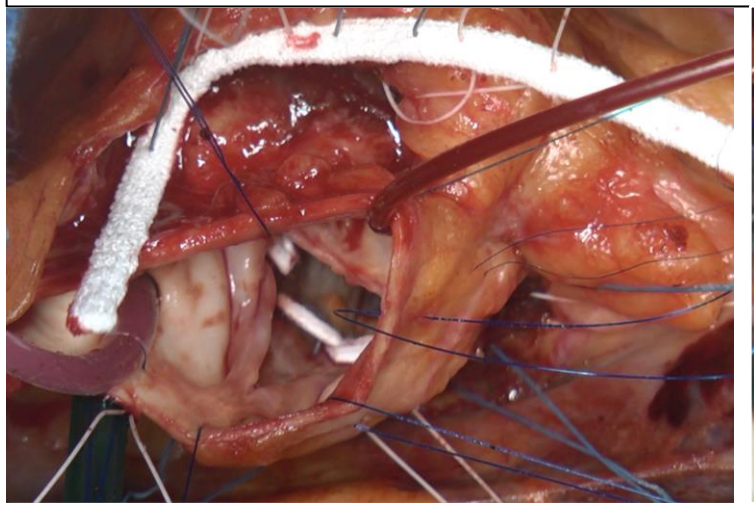
Large VAJ (>28-30 mm)
Root Wall disease
Remodel BAV geometry → 180°

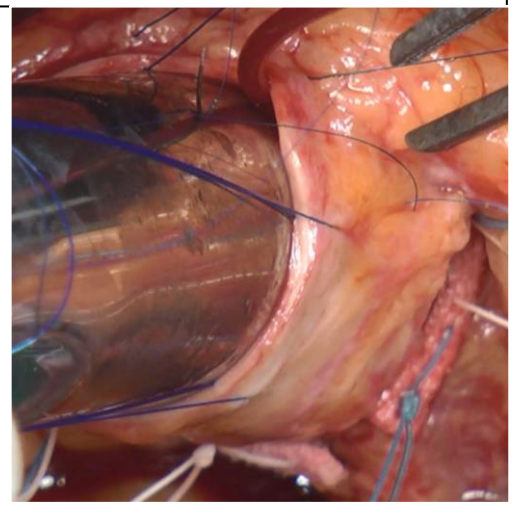
No Annuloplasty or
Subcom. annuloplsty

External Ring Annuloplasty

VS Reimplantion





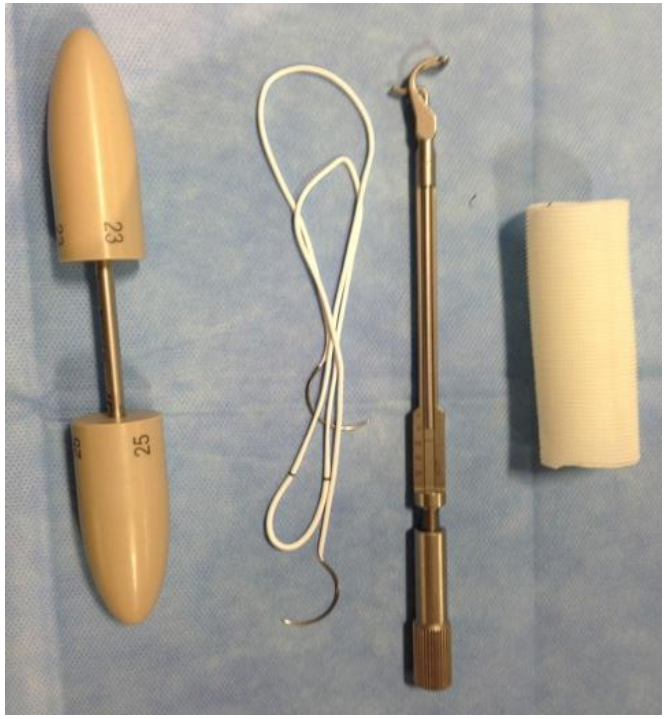


Surgical Toolset for Reimplantation

« Survival Kit »

Brussels Technique

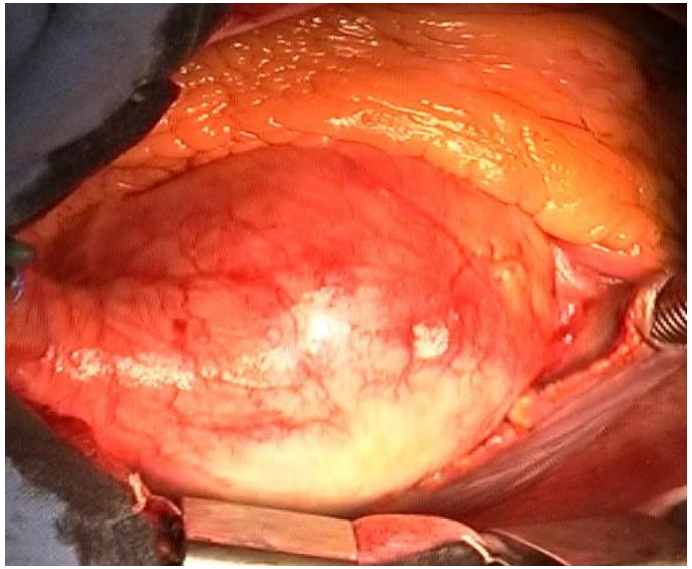
Homburg technique

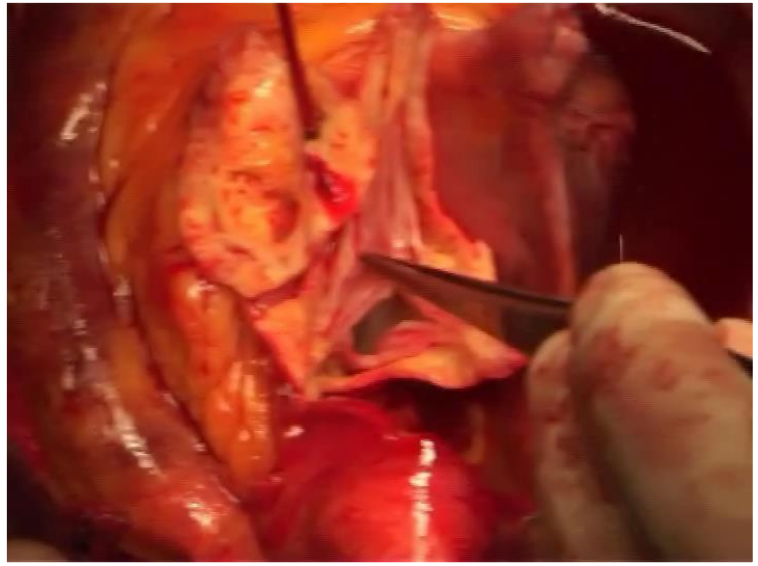


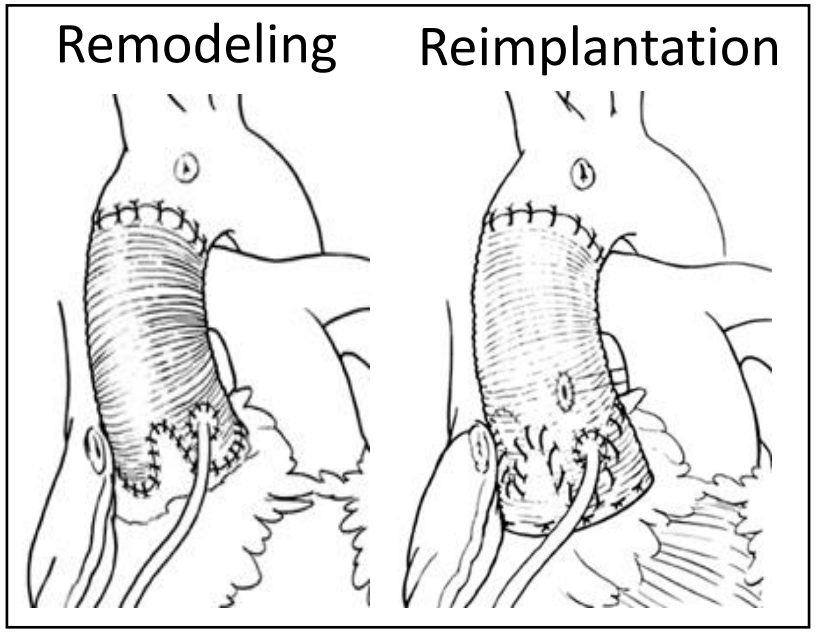
Paris technique

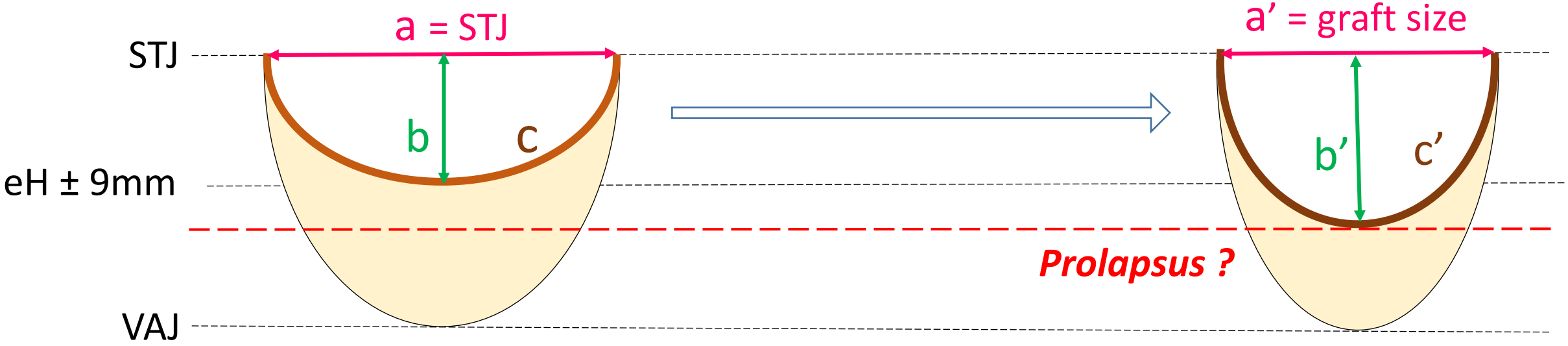
Principles of Aortic Valve-Sparing Reimplantation Technique

Root Replacement



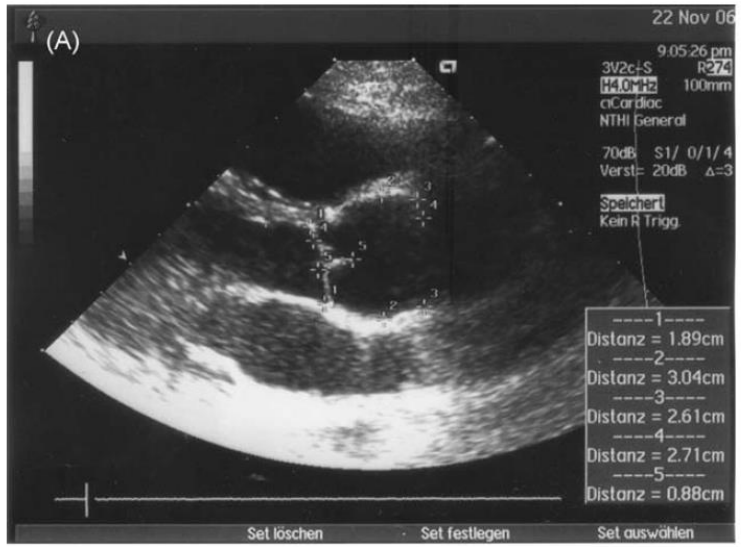






Principles of Aortic Valve-Sparing Reimplantation Technique

Effective Height



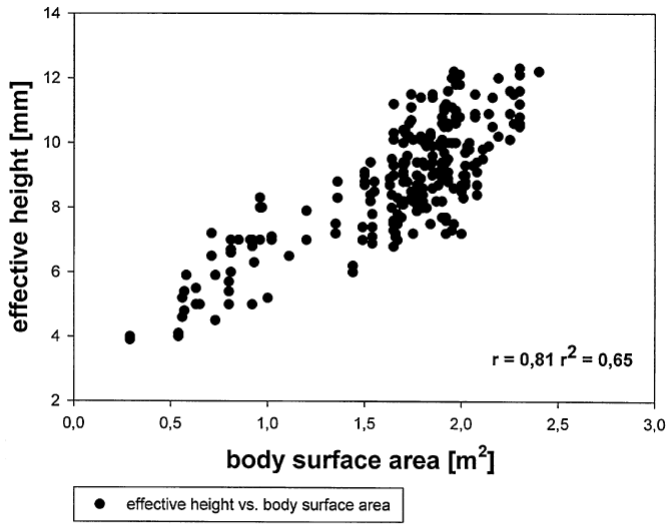
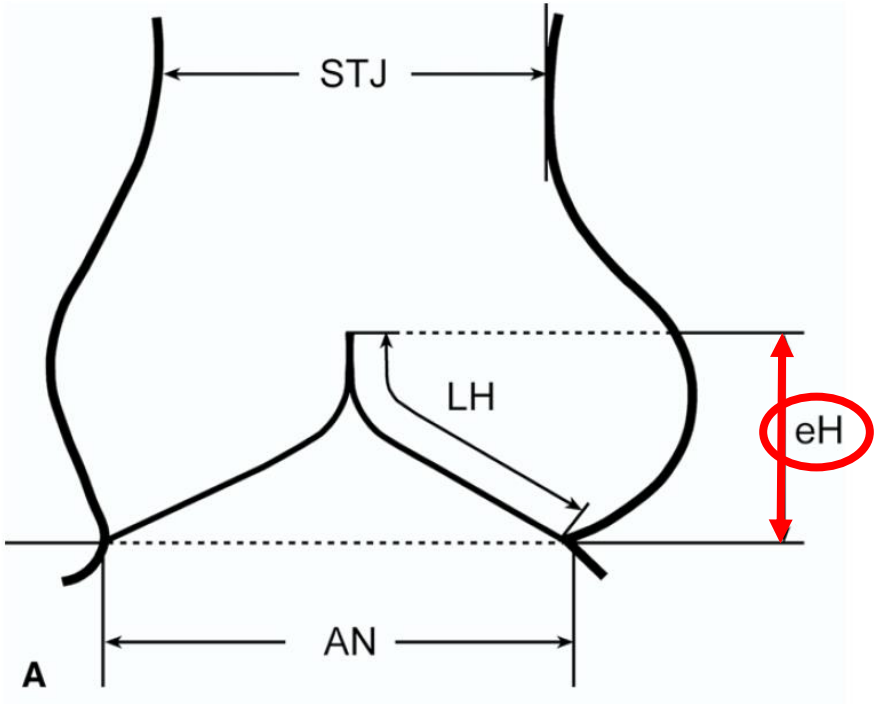
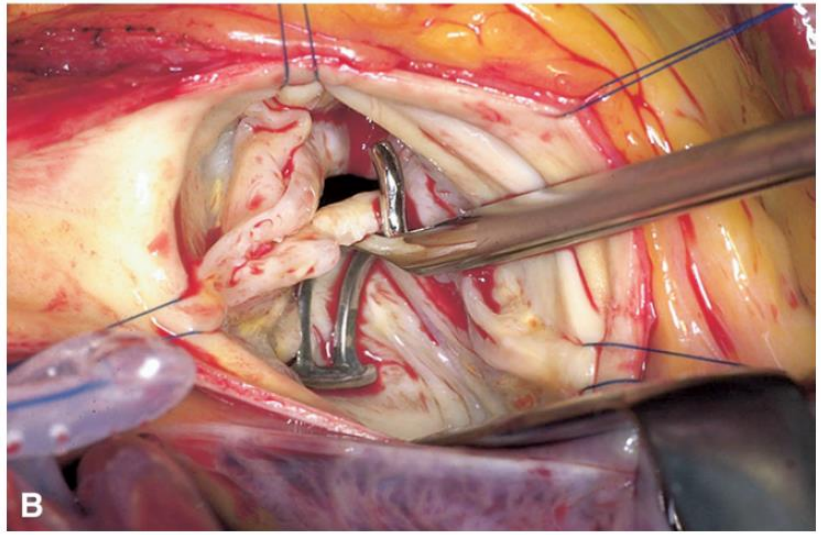


Fig. 4. Effective height in relation to body surface area in healthy individuals.





Schäfers H.J., JTCVS 2006; 132:436-8

Bierbarch B.O., Shäfers H.J., EJCTS. 2010; 38:400-406

A. Valve-Sparing Reimplantation in TAV

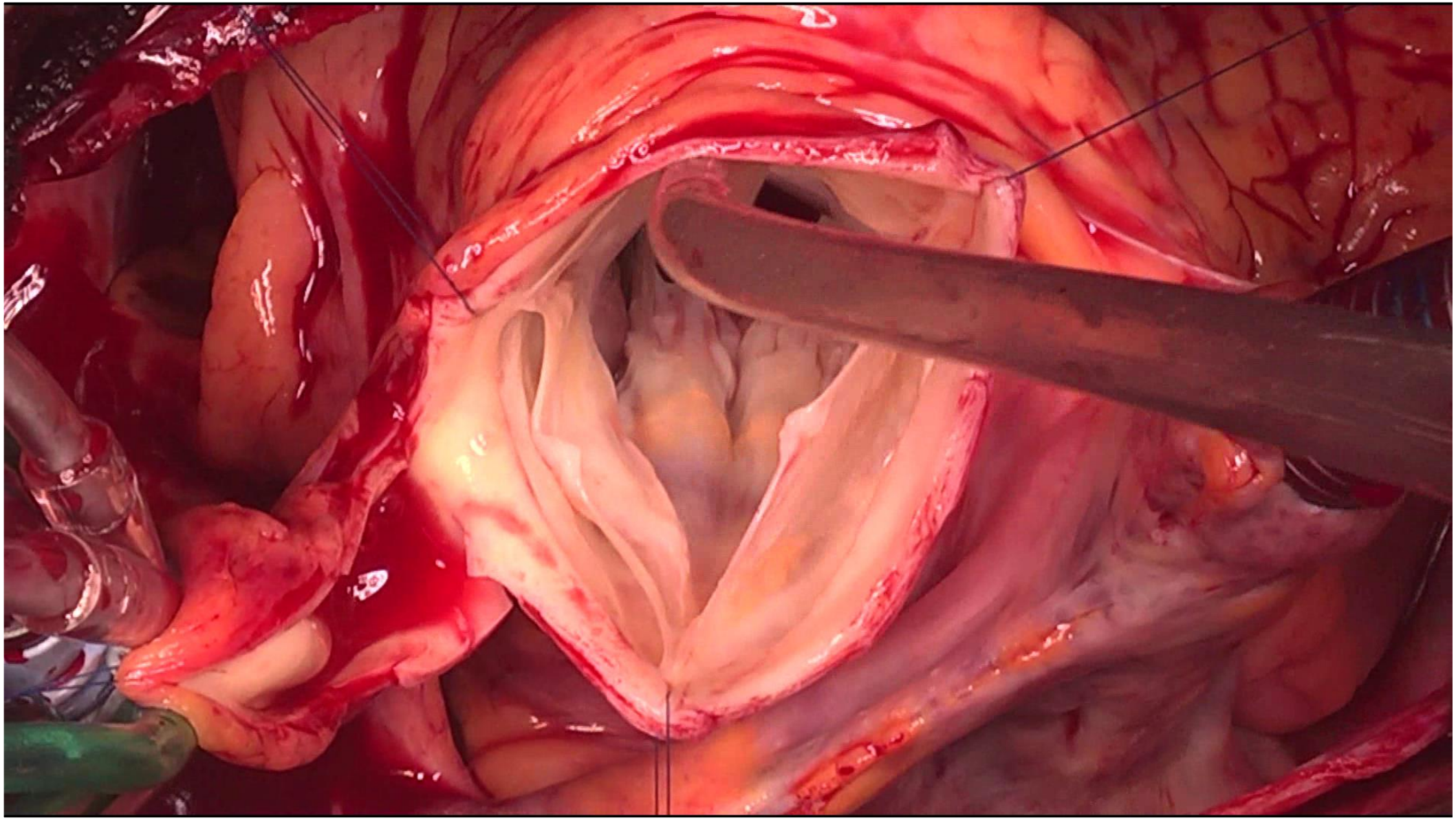
A. Valve-Sparing Reimplantation in TAV

Step-by-Step

1. Root preparation ← Cusp inspection
2. Graft sizing ← Cusp repair (complex repair)
3. Proximal suture line
4. Graft trimming
5. Com. reimplantation & distal suture line
6. Coronary reimplantation ← Cusp repair (prolapse repair)
7. Distal anastomosis

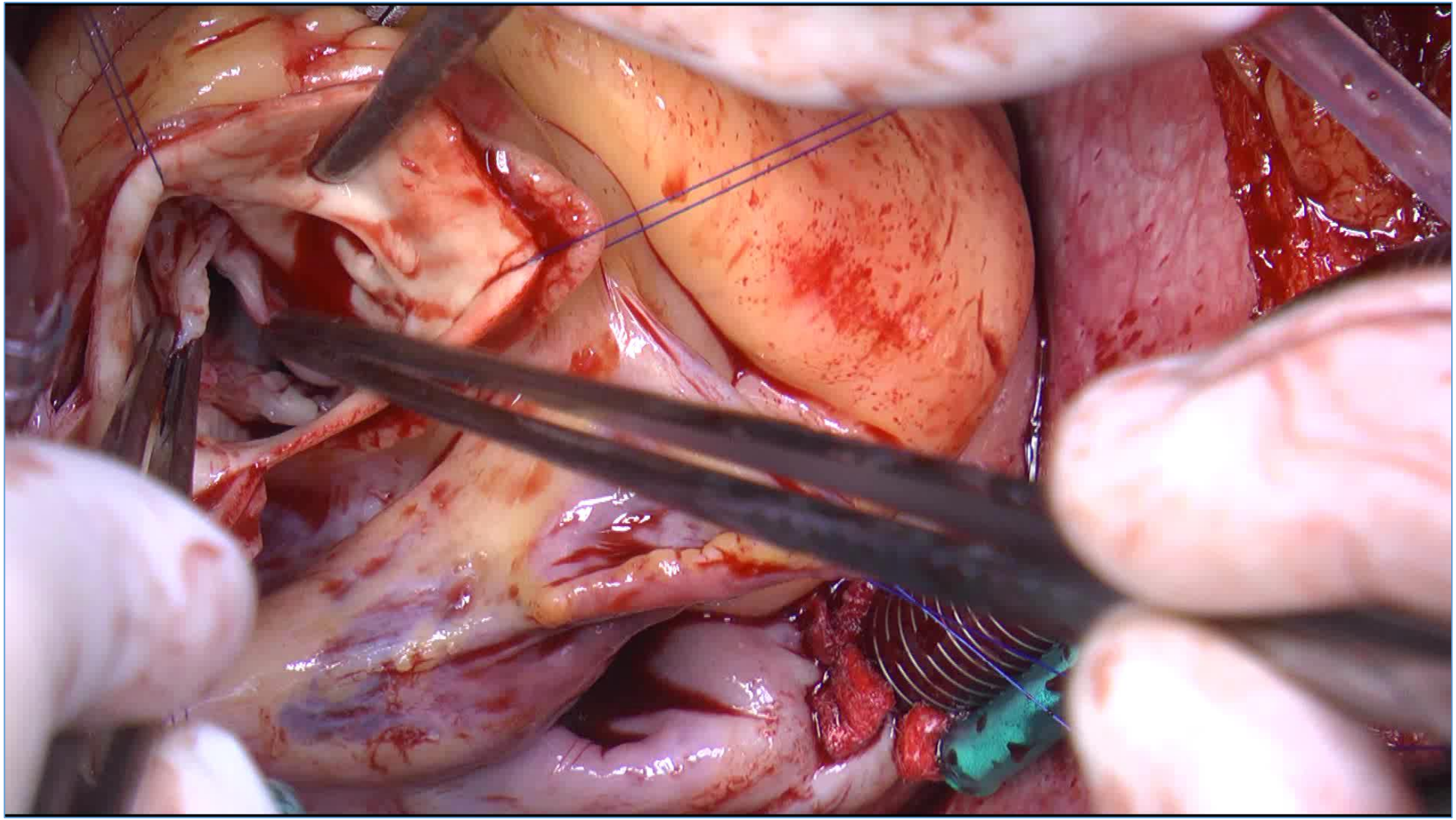
A. Valve-Sparing Reimplantation in TAV

Root Preparation



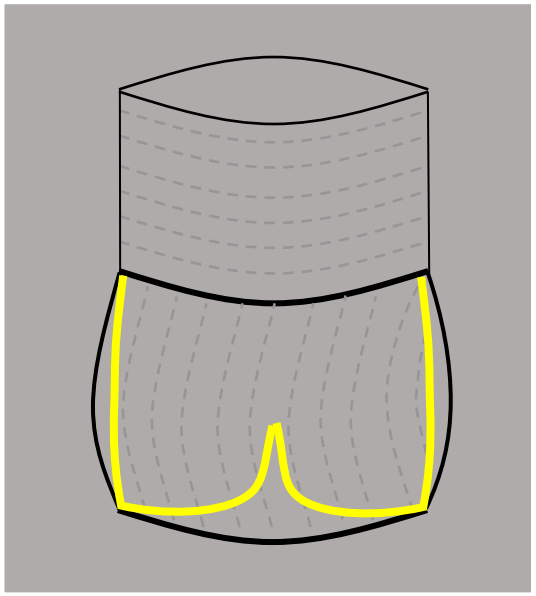
A. Valve-Sparing Reimplantation in TAV

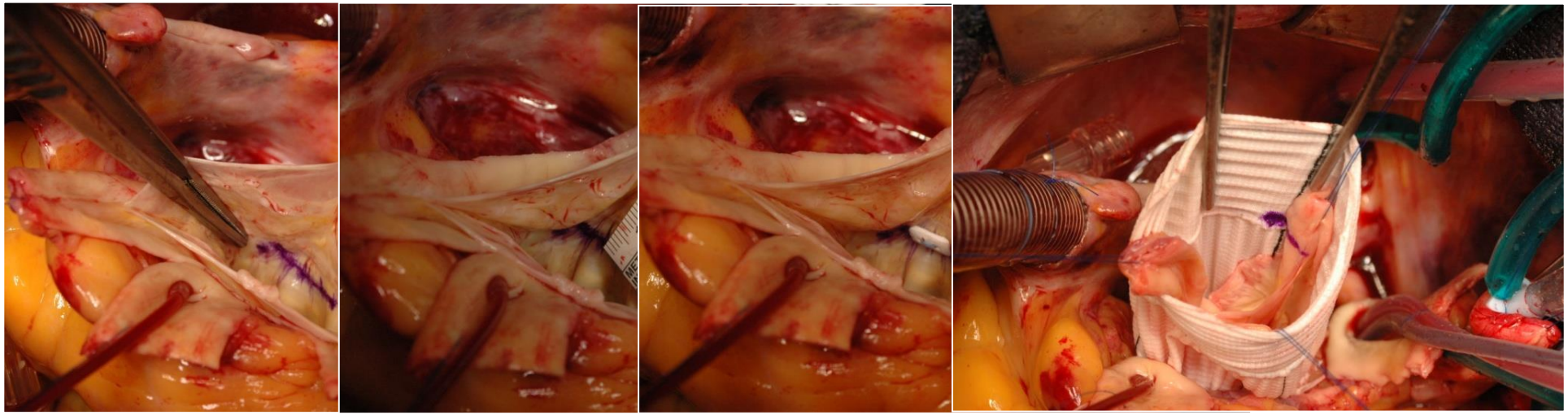
Complex Cusp Repair



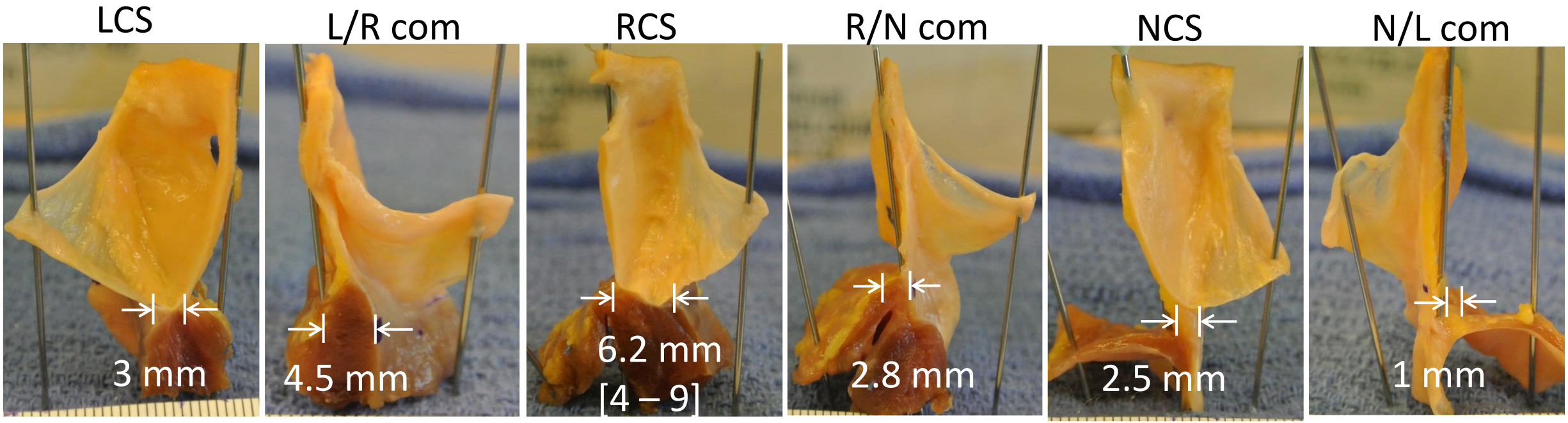
A. Valve-Sparing Reimplantation in TAV

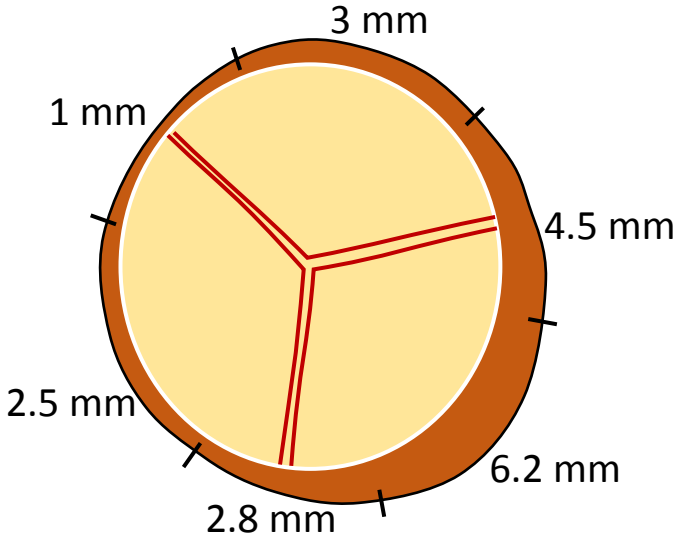
Graft Sizing: **N/L Comm Height** Method





VAJ annuloplasty sizing





Mean AVJ thickness = 3.2 mm

With external graft,

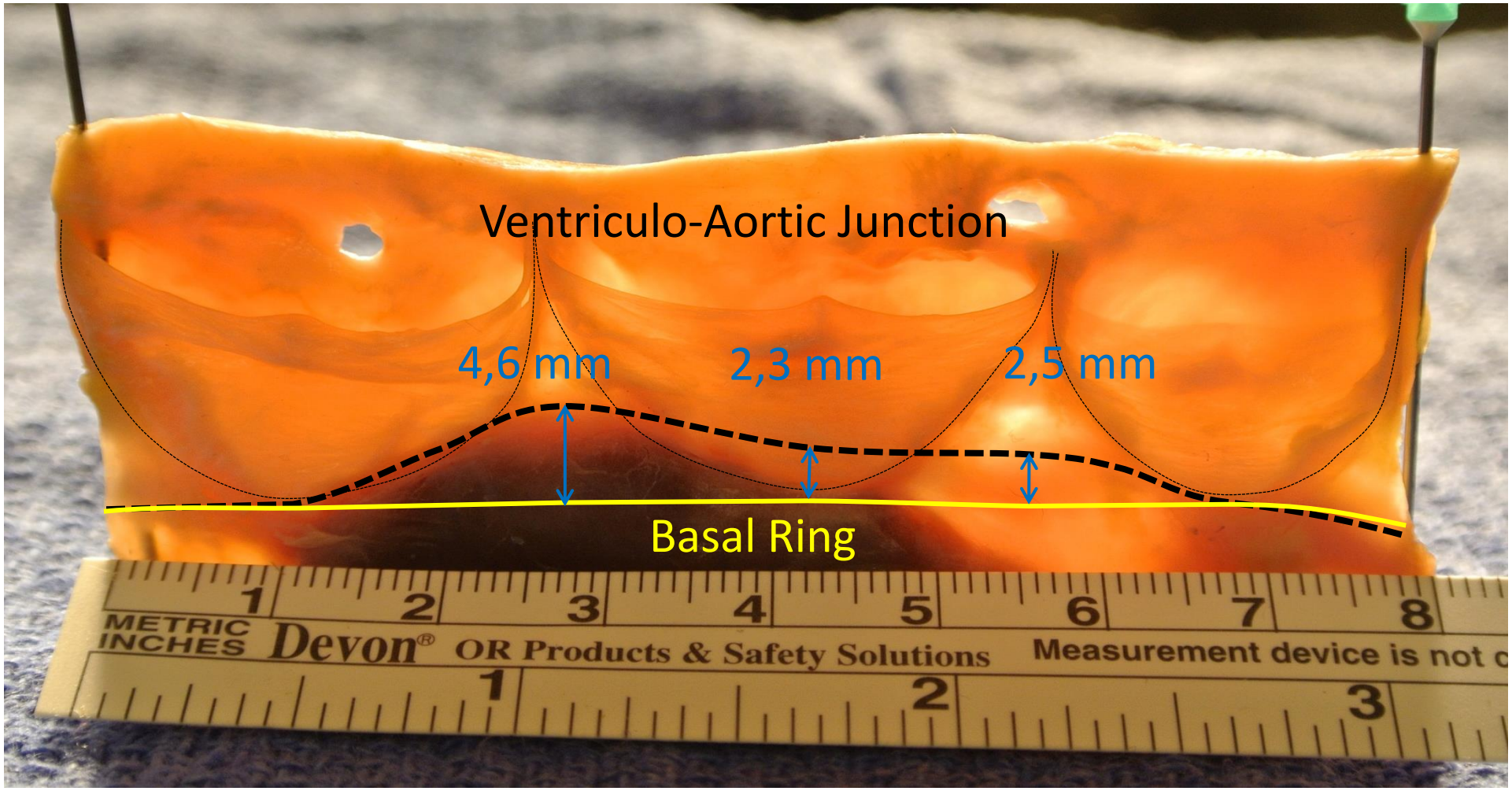
expected final annulus diameter

= graft Ø – 6 to 7 mm

Graft / Ring diameter	Expected AVJ diameter
26	± 20
28	± 22
30	± 24
32	± 26
34	± 28

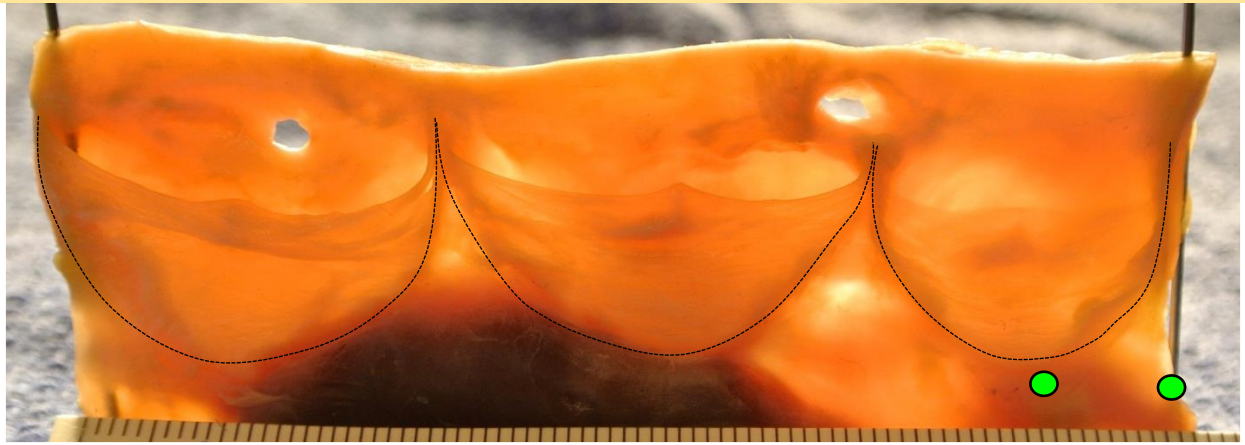
Surgical Anatomy of the Aortic Valve

Geometry of the Ventriculo-Aortic Junction

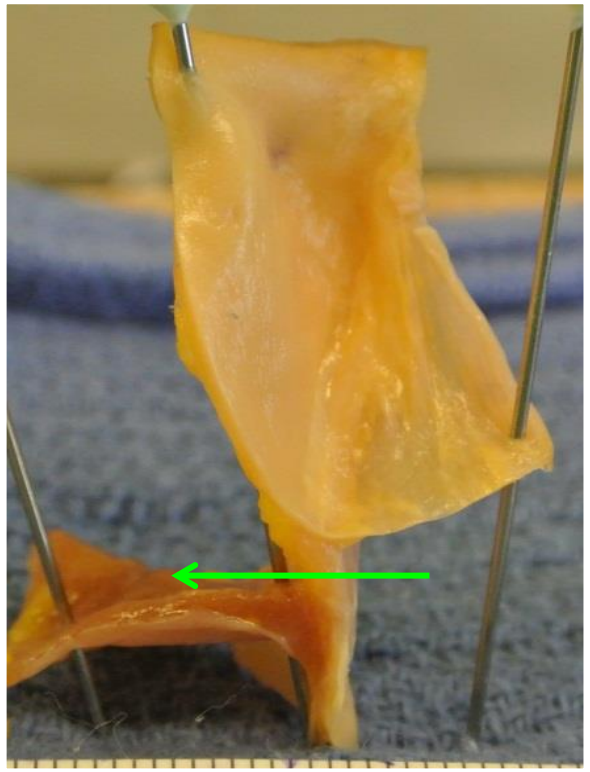


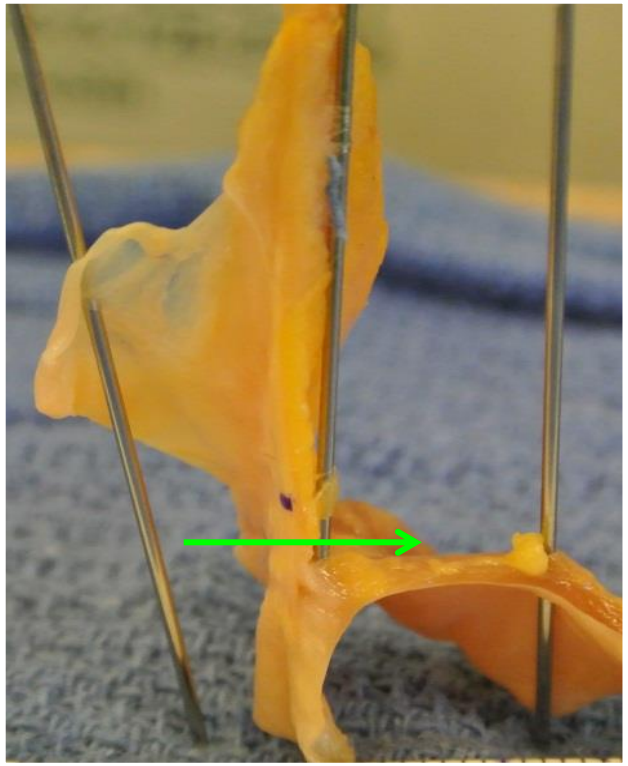
A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line: Non Coronary Sinus



NCS

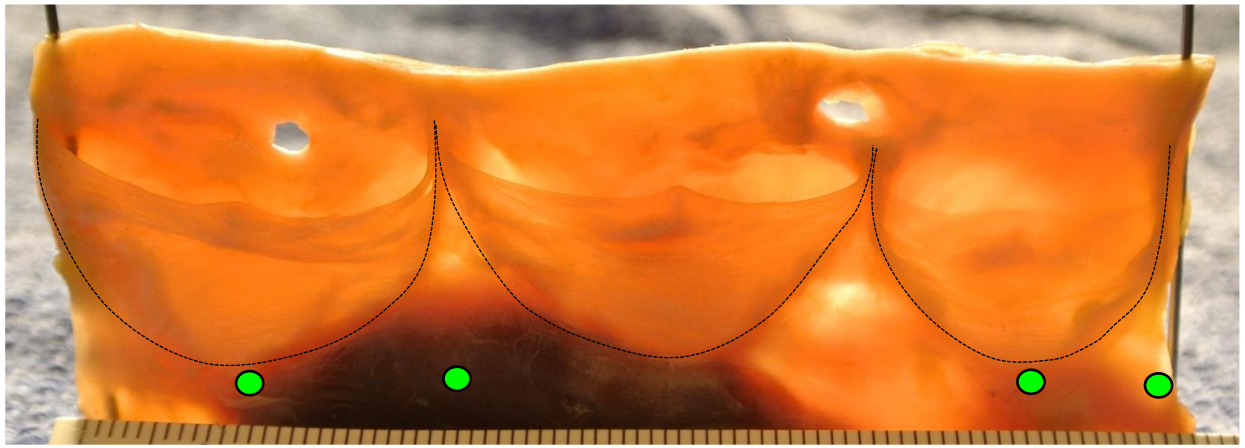




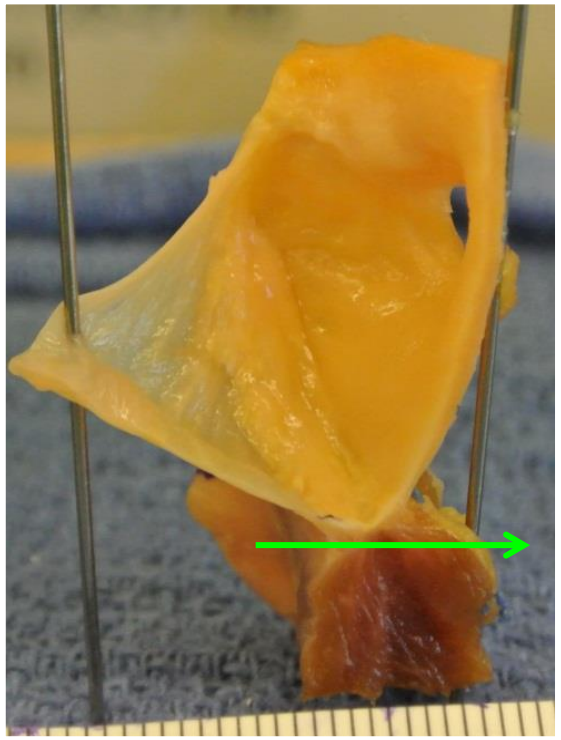
N/L com

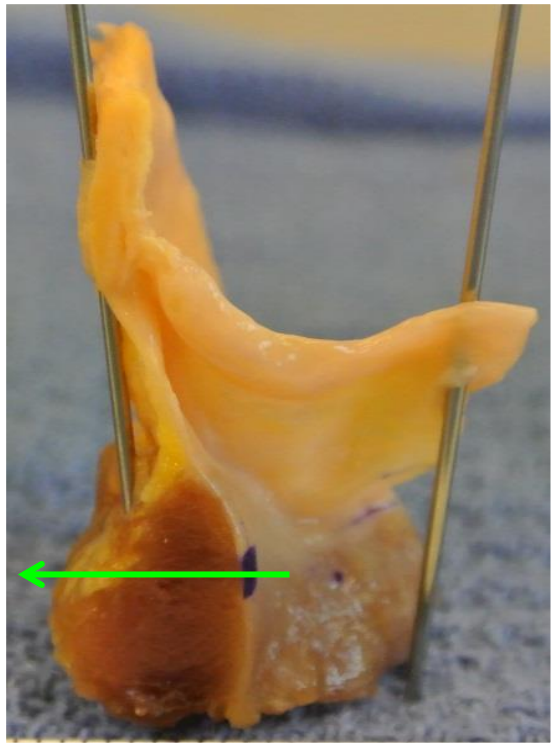
A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line: Left Coronary Sinus



LCS

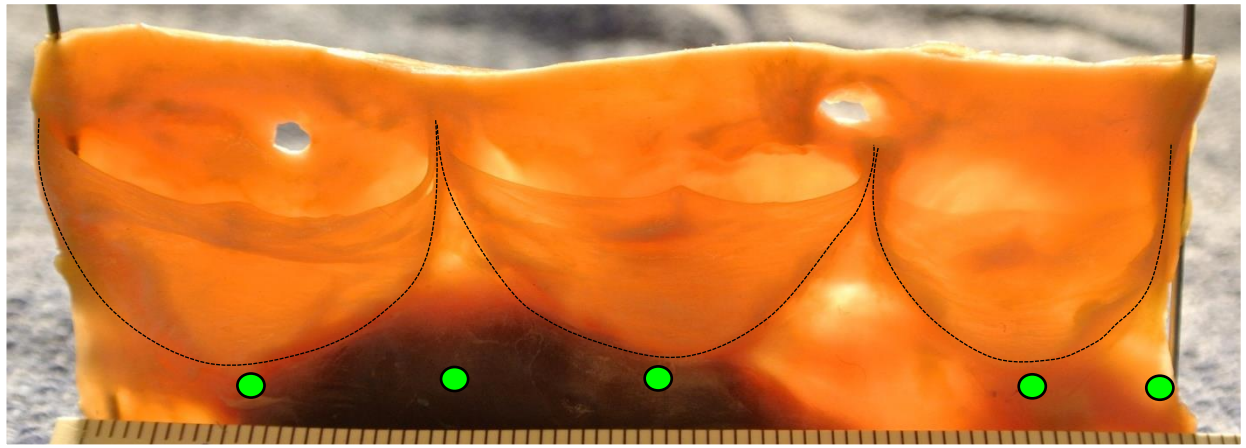




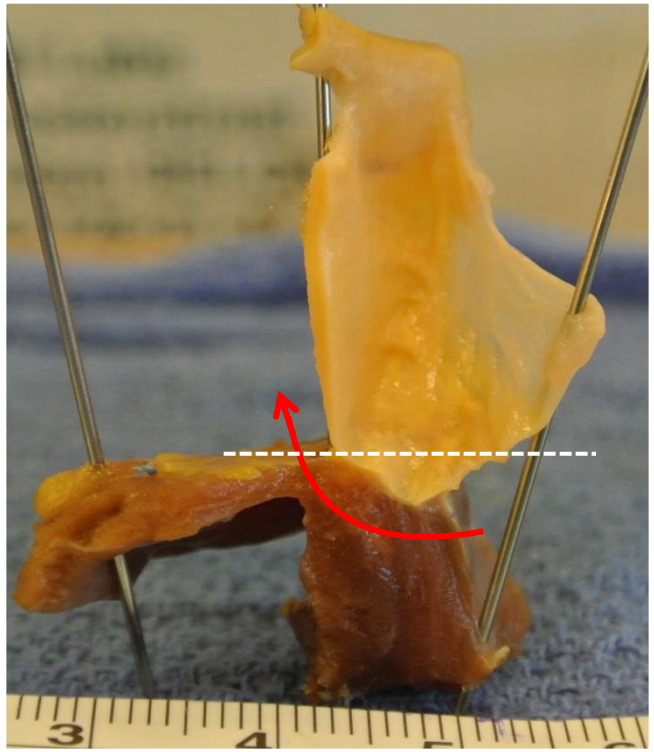
L/R com

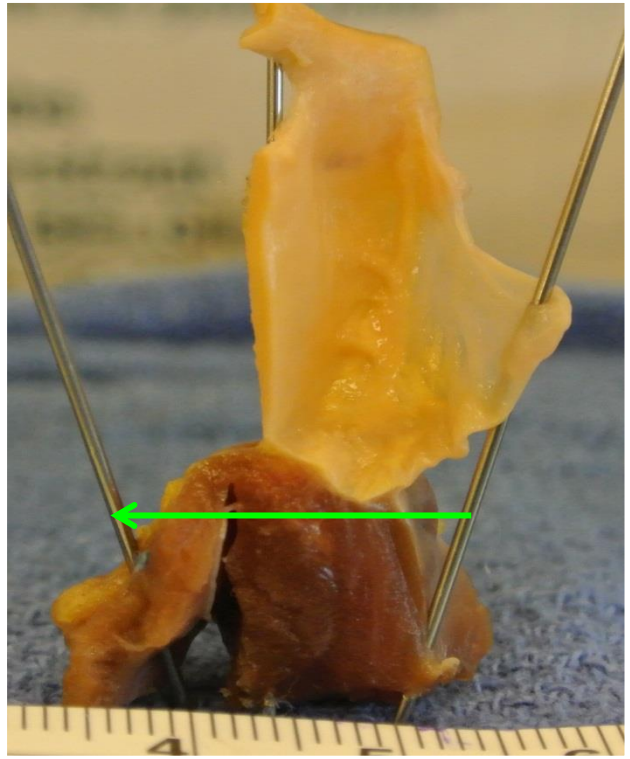
A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line: Right Coronary Sinus



RCS

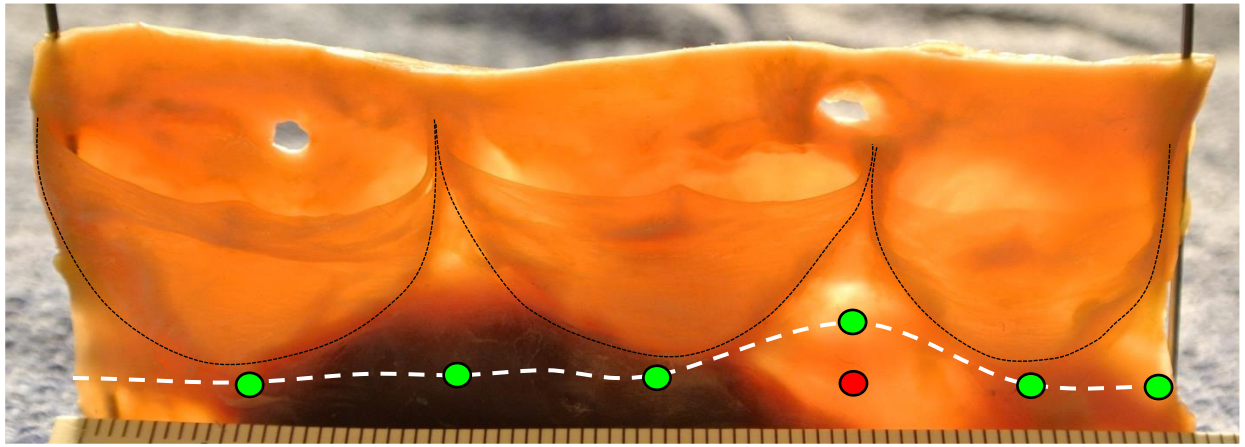


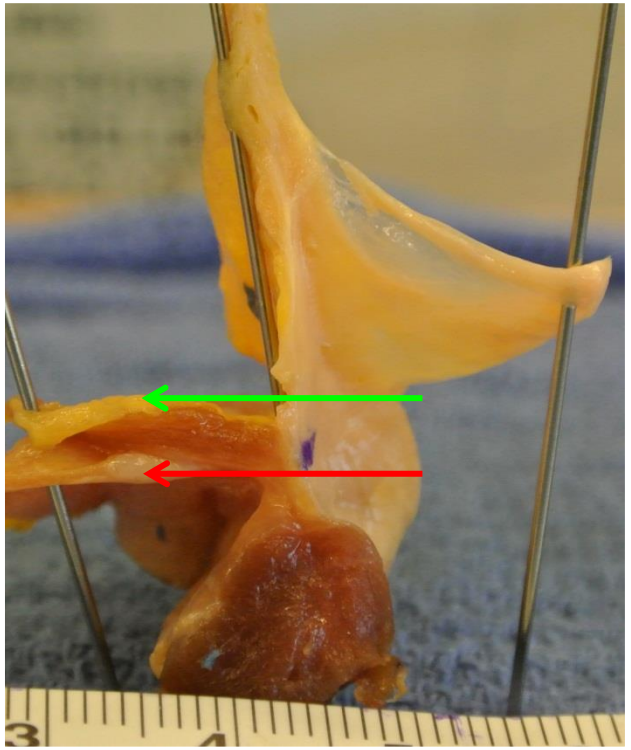


RCS

A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line: R/N Comm

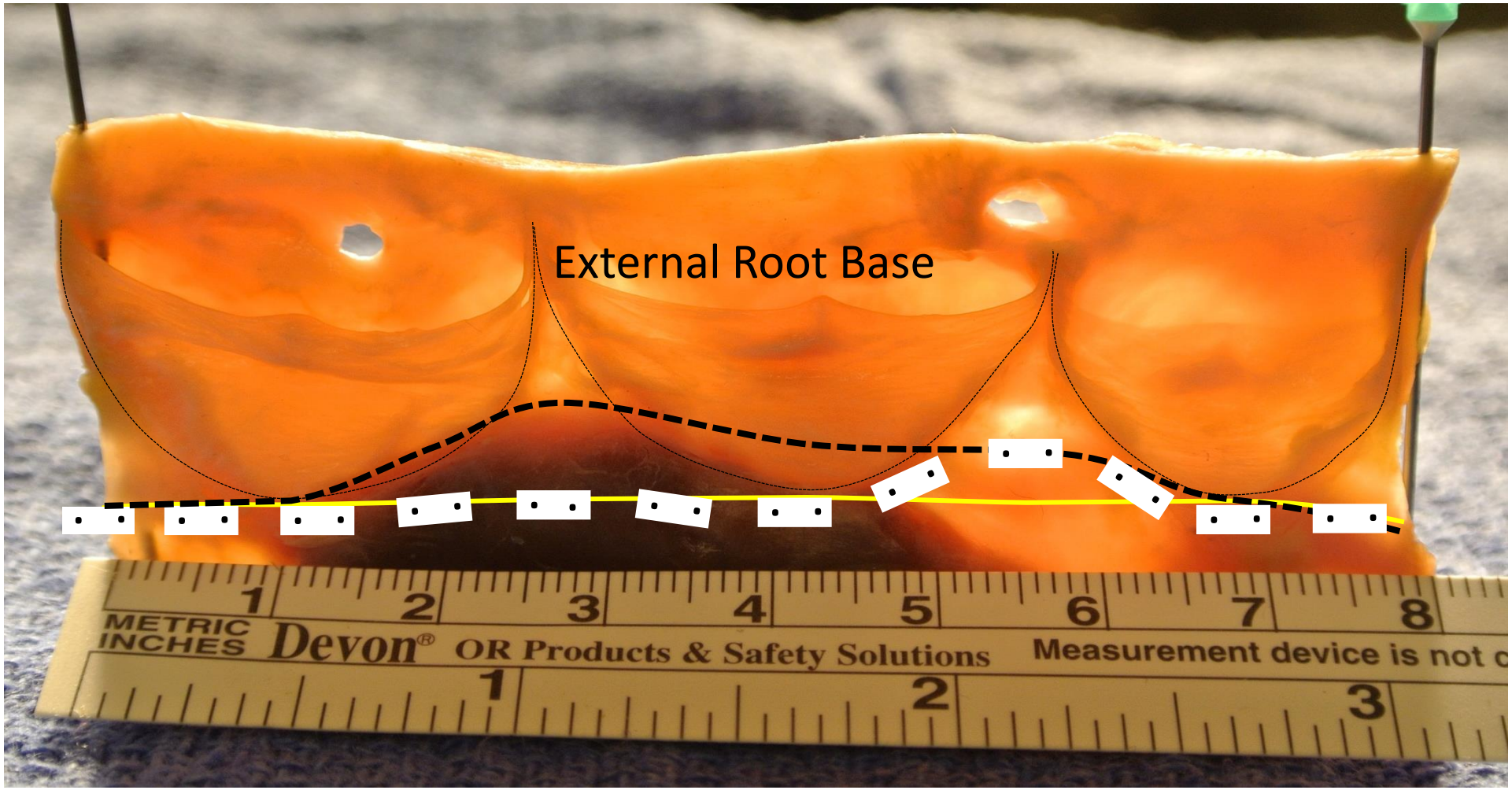




R/N com

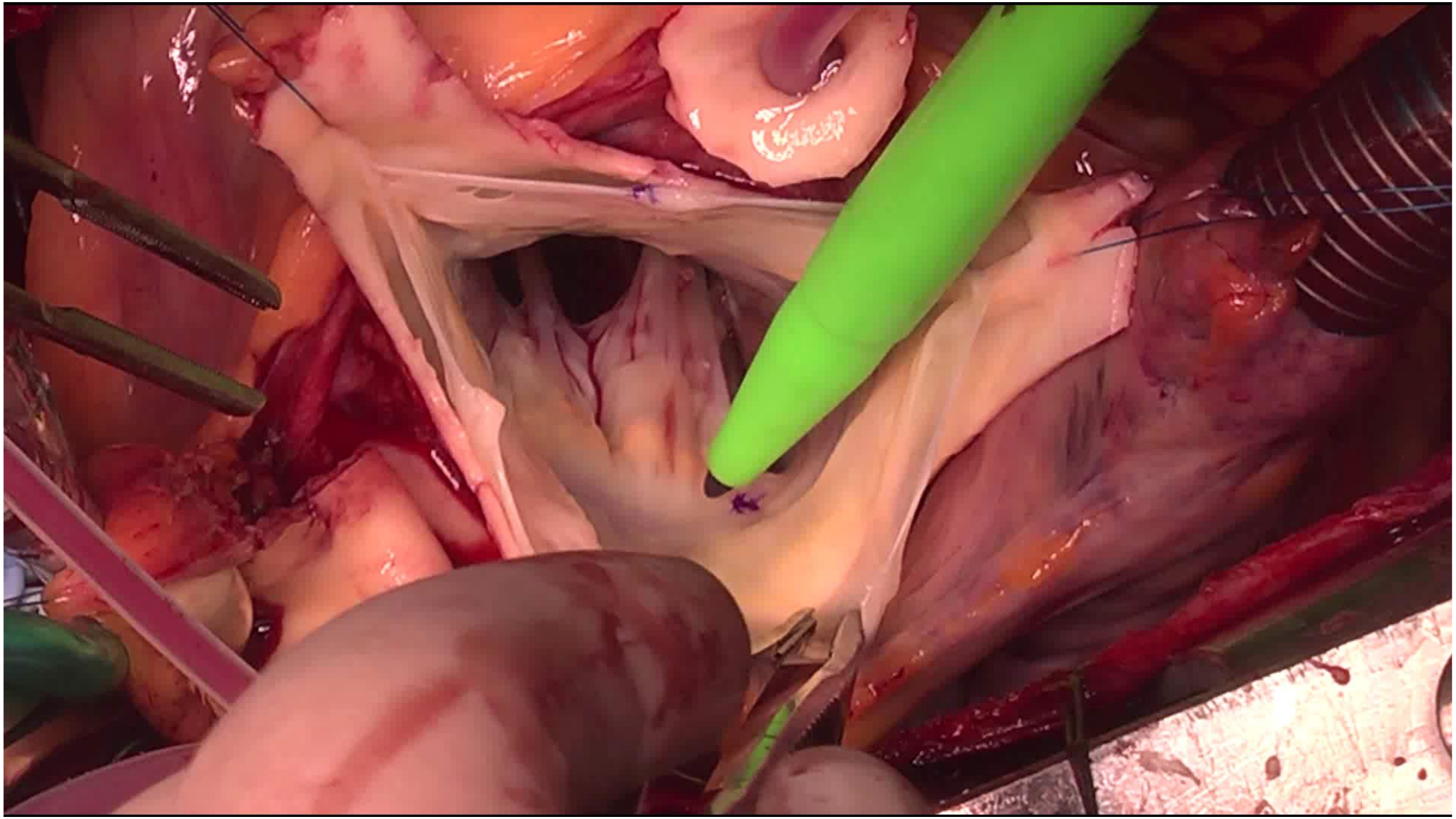
A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line: Teflon Suture Placement



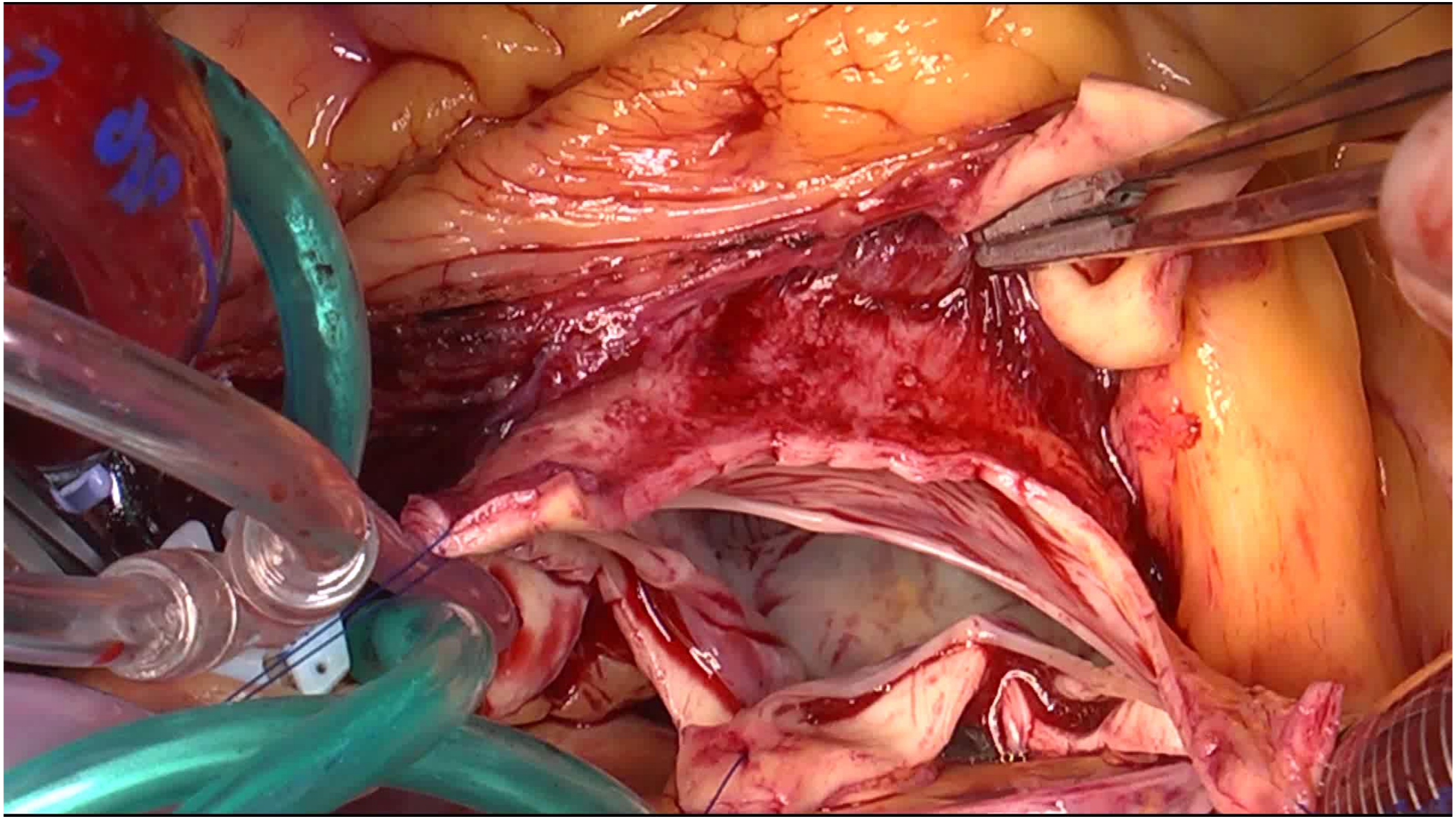
A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line



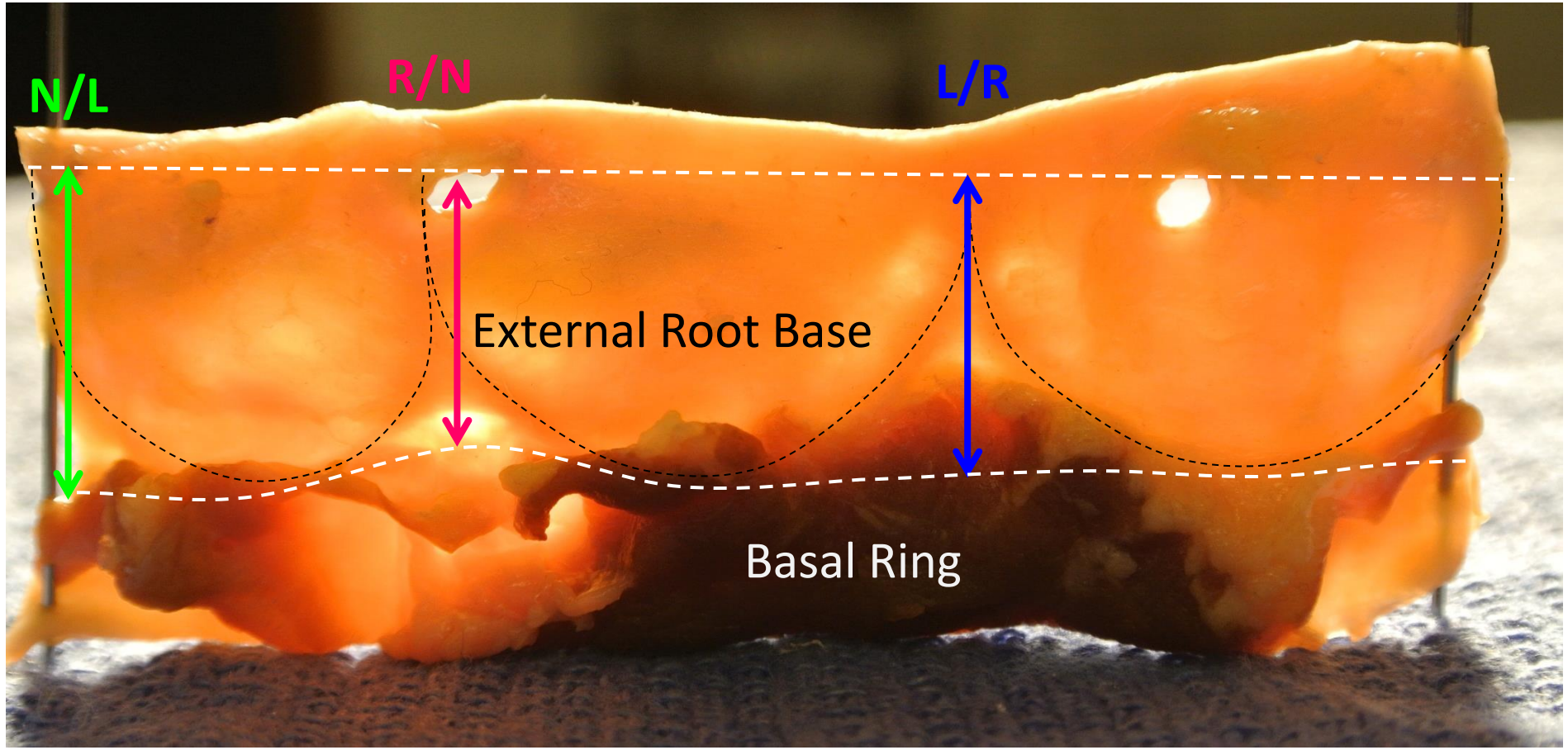
A. Valve-Sparing Reimplantation in TAV

Proximal Suture Line: Right Coronary Sinus Deep Dissection



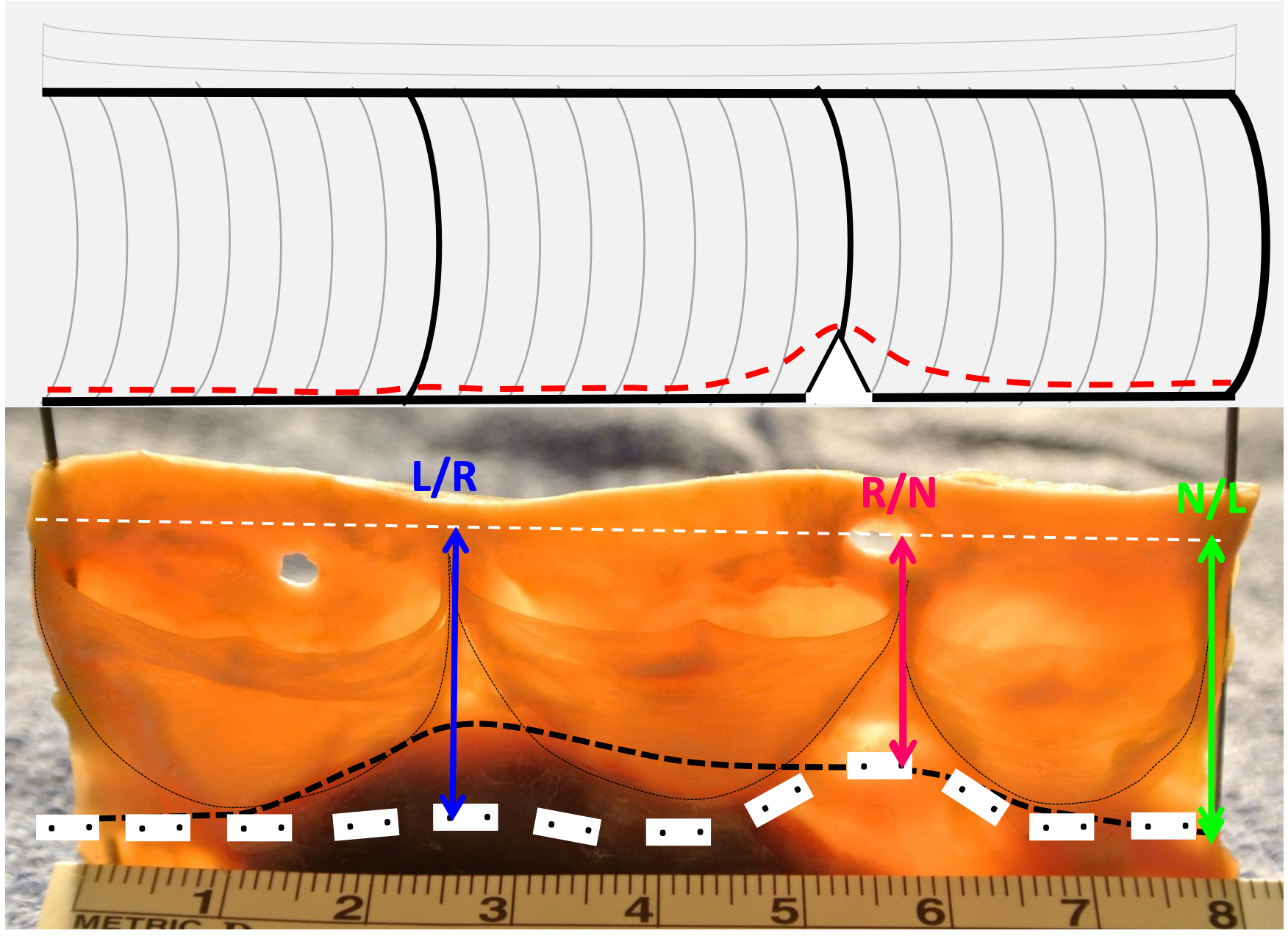
A. Valve-Sparing Reimplantation in TAV

Graft Trimming to fit External Root Asymmetry



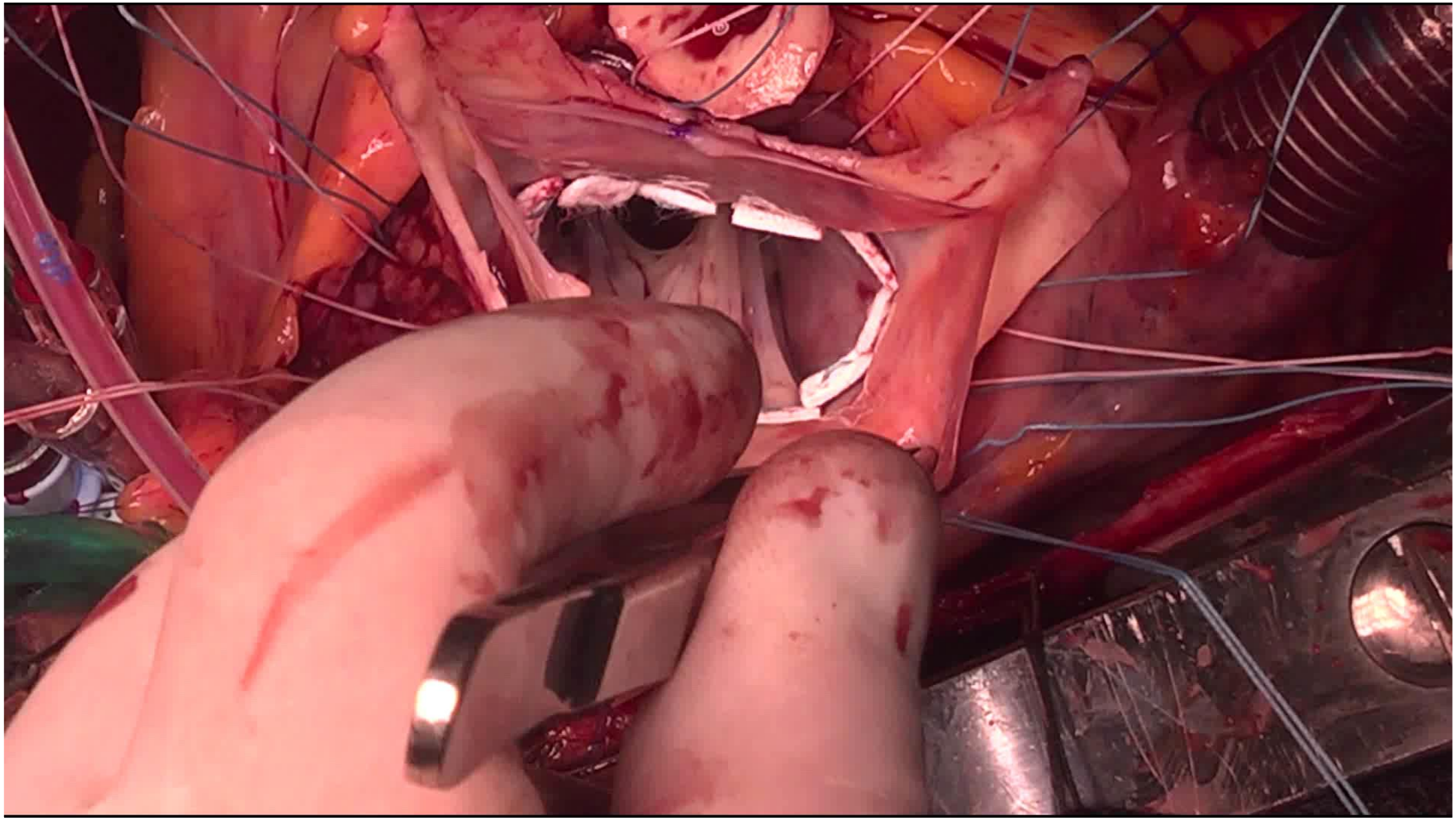
A. Valve-Sparing Reimplantation in TAV

Graft Trimming to fit External Root Asymmetry



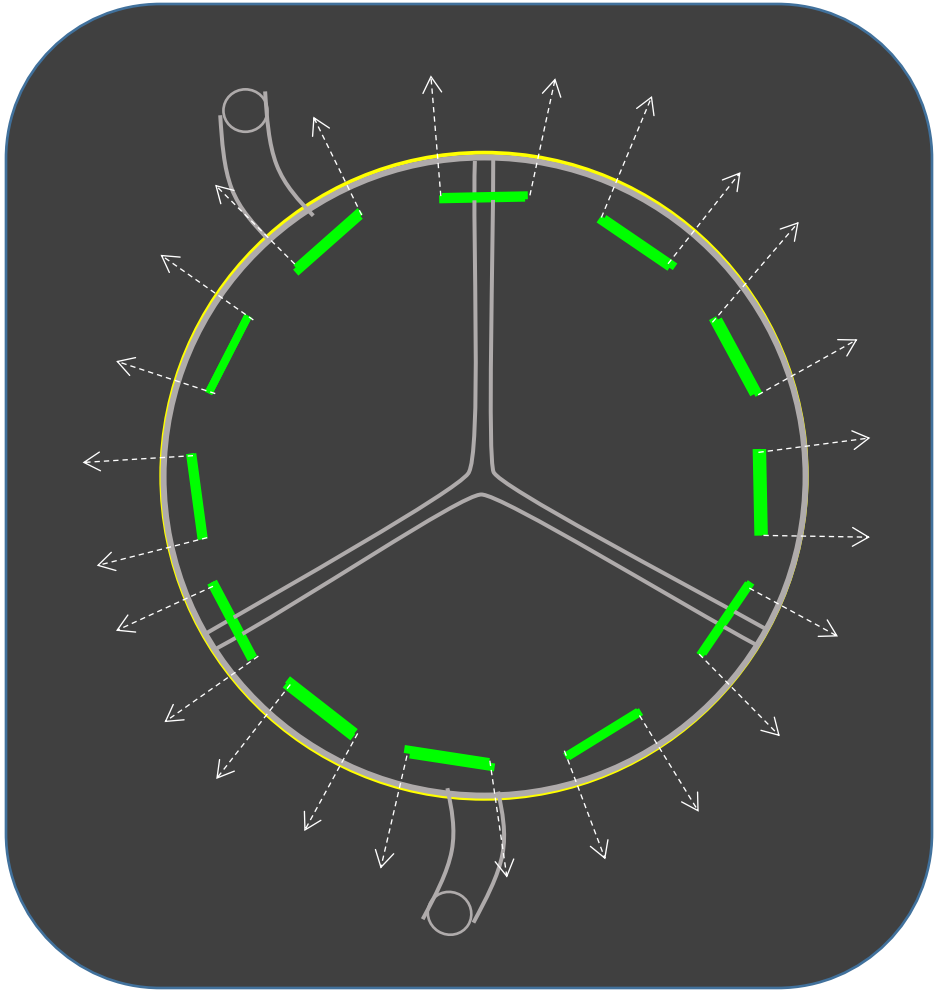
A. Valve-Sparing Reimplantation in TAV

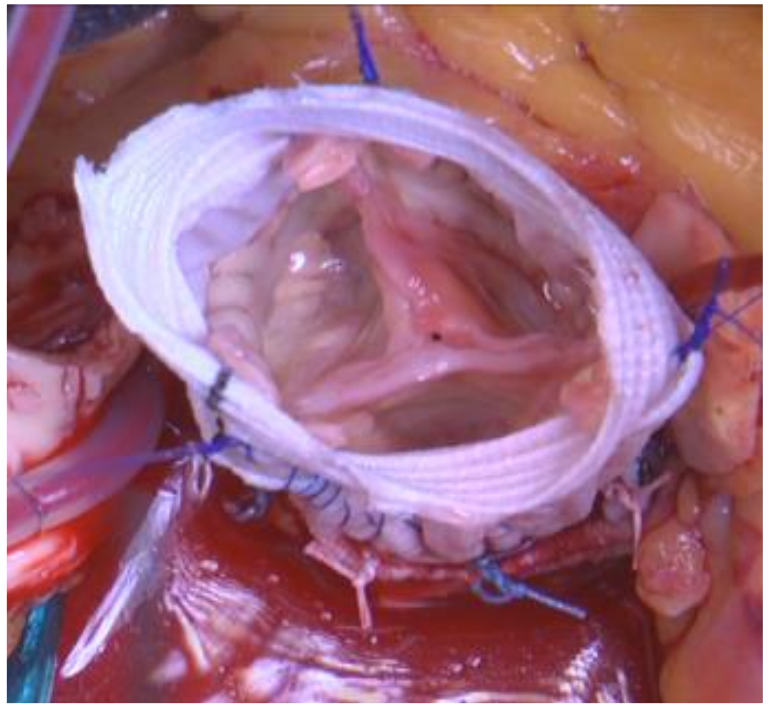
Graft Trimming to fit External Root Asymmetry



A. Valve-Sparing Reimplantation in TAV

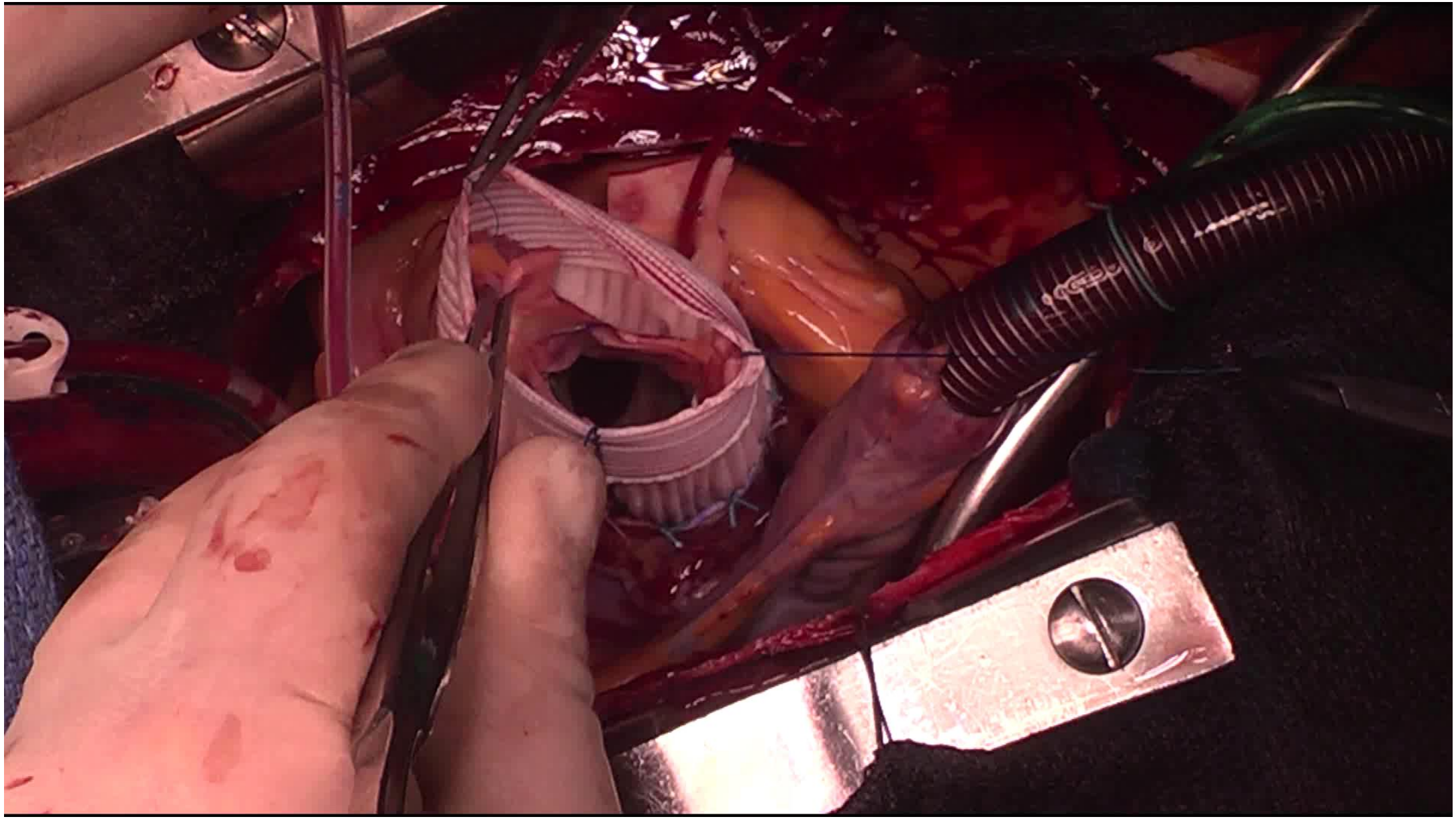
Proximal Suture Line effect on VAJ





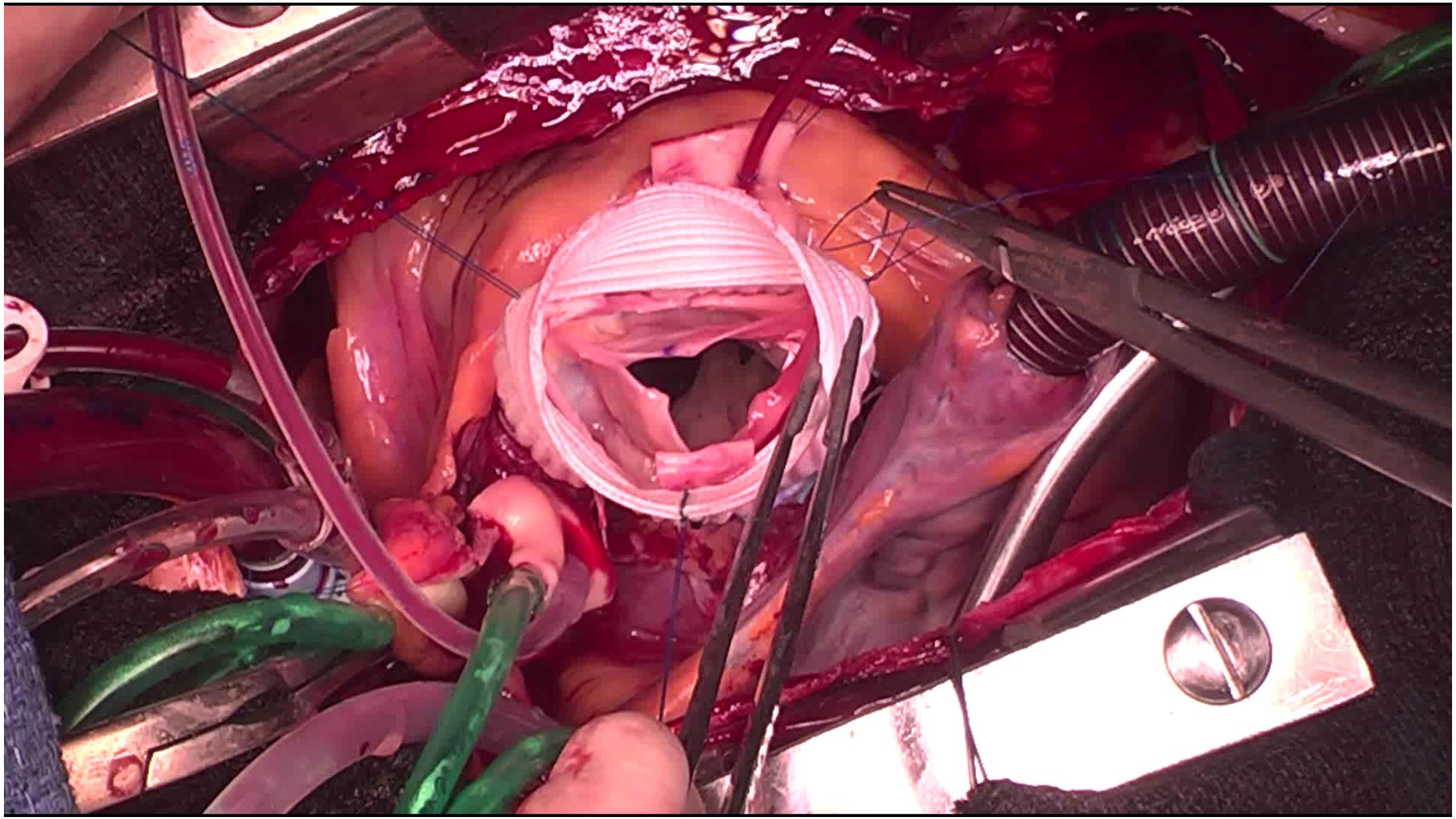
A. Valve-Sparing Reimplantation in TAV

Commissure Reimplantation on Neo-STJ



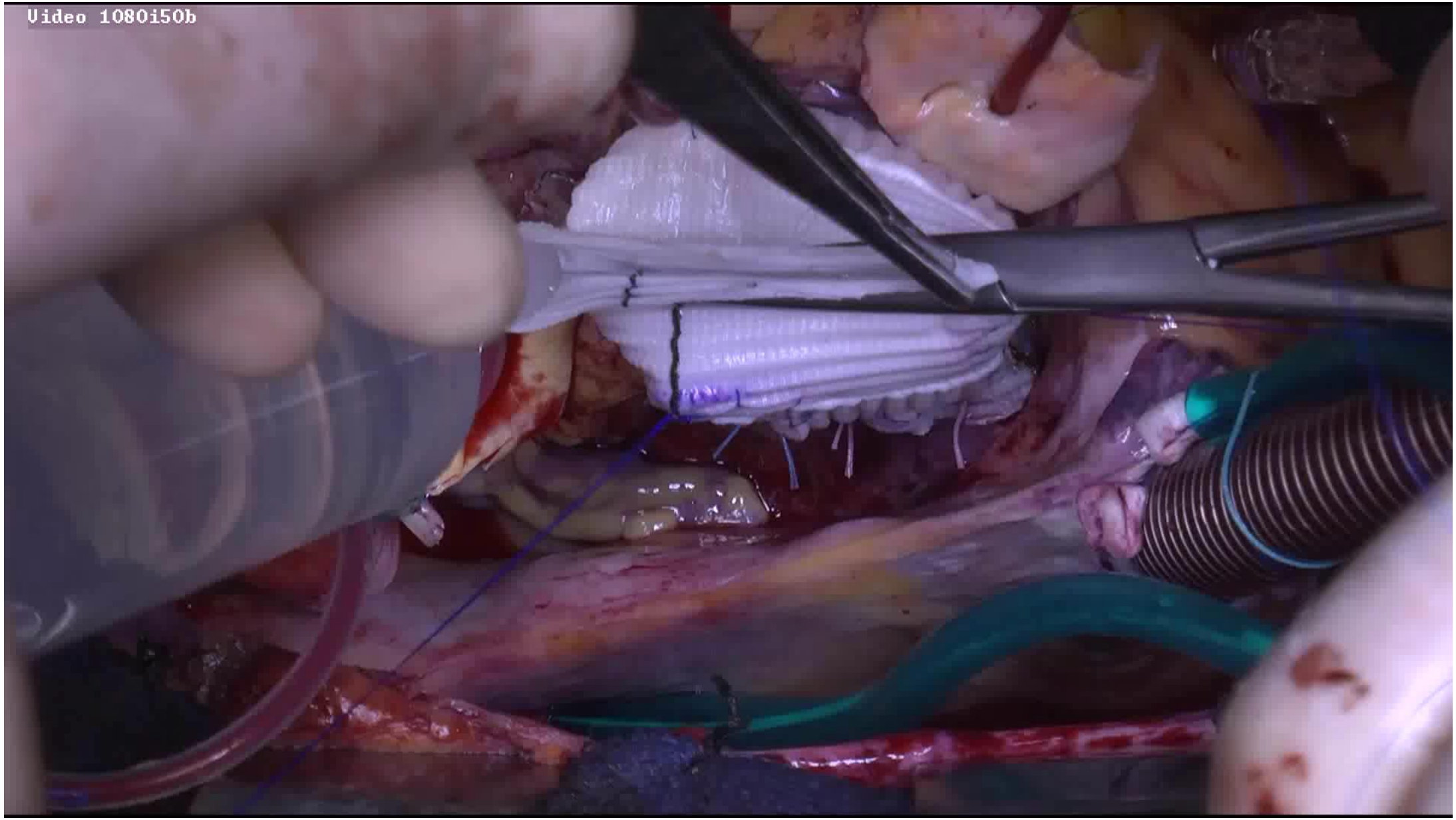
A. Valve-Sparing Reimplantation in TAV

Distal Suture Line



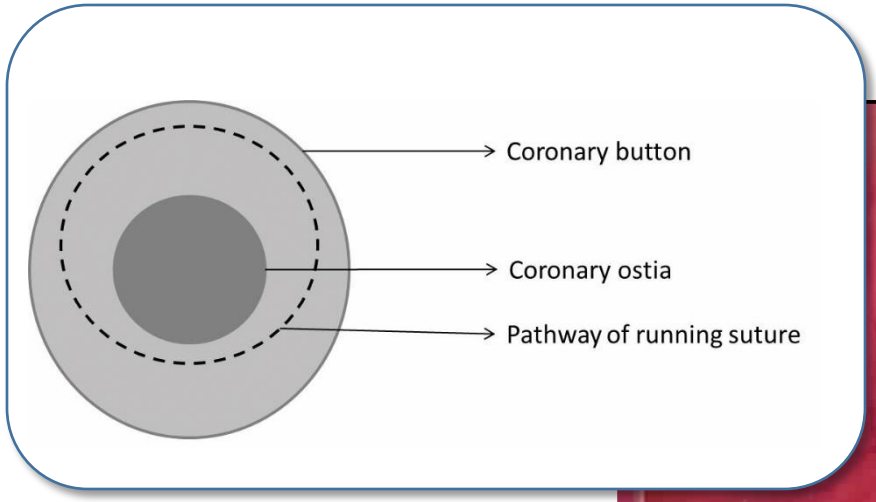
A. Valve-Sparing Reimplantation in TAV

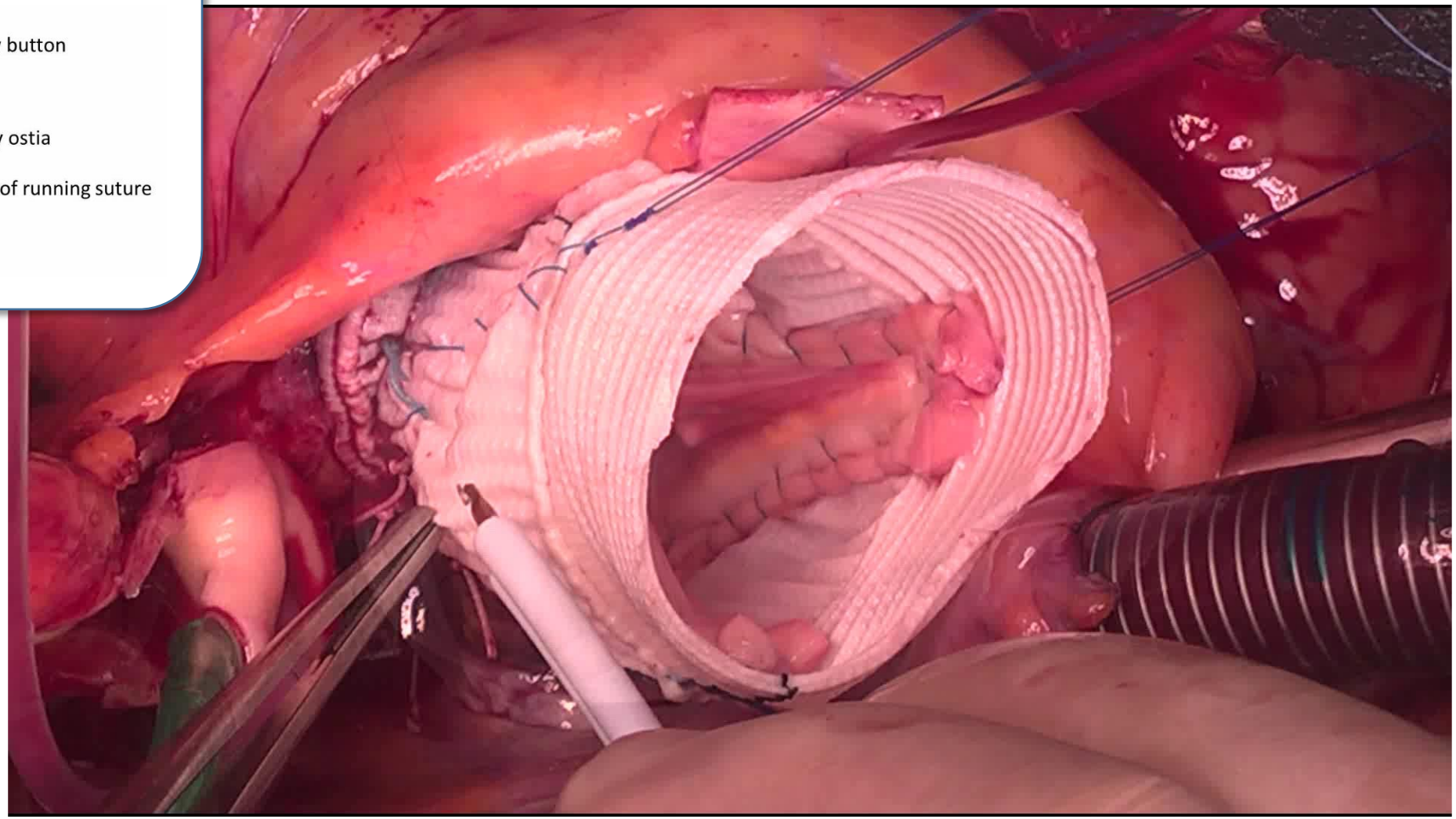
Cusp Inspection, Prolapse Repair



A. Valve-Sparing Reimplantation in TAV

Coronary Ostia Reimplantation and Distal Anastomosis





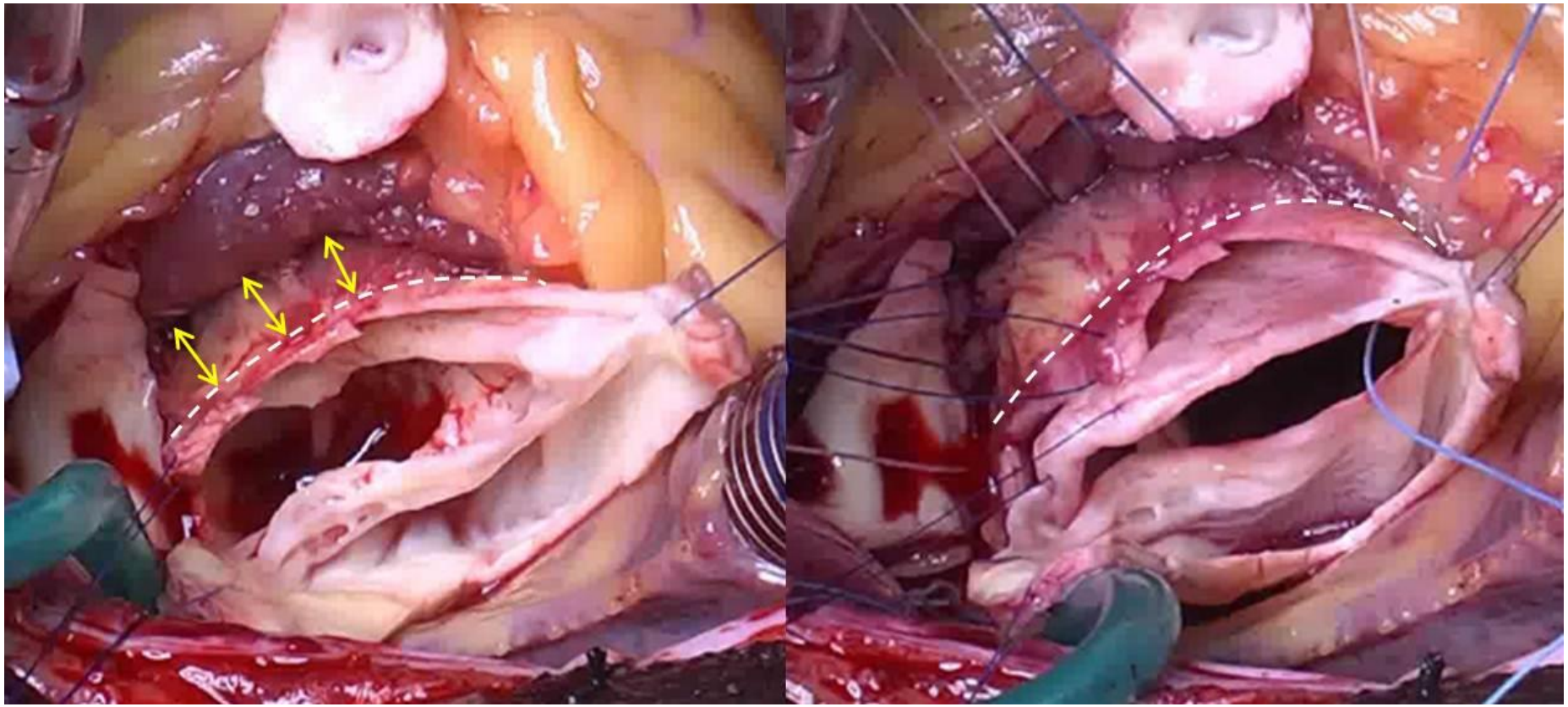
B. Valve-Sparing Reimplantation in BAV

B. Valve-Sparing Reimplantation in BAV

Step-by-Step

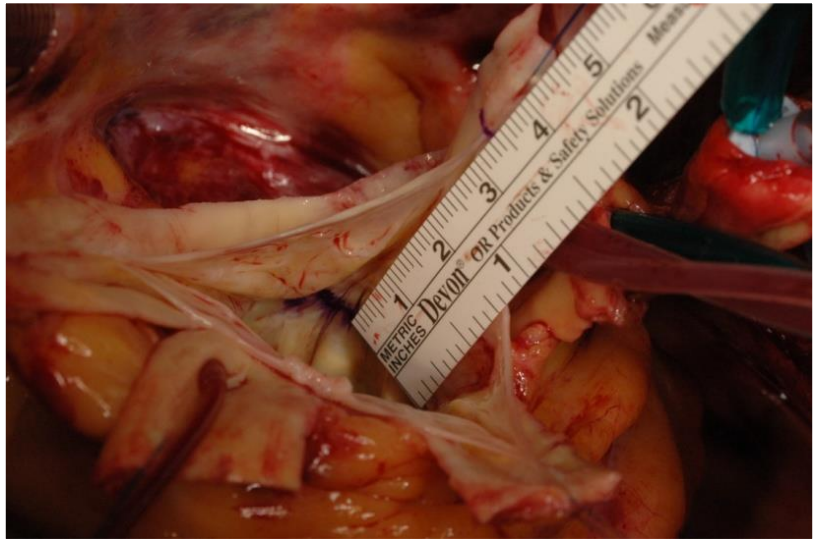
1. Root preparation ← **Cusp inspection**
2. Graft sizing
3. Proximal suture line
4. Graft trimming ← **Cusp repair (raphe)**
5. Com. reimpl. & distal suture line
6. Coronary reimplantation ← **Cusp repair (prolapse repair)**
7. Distal anastomosis

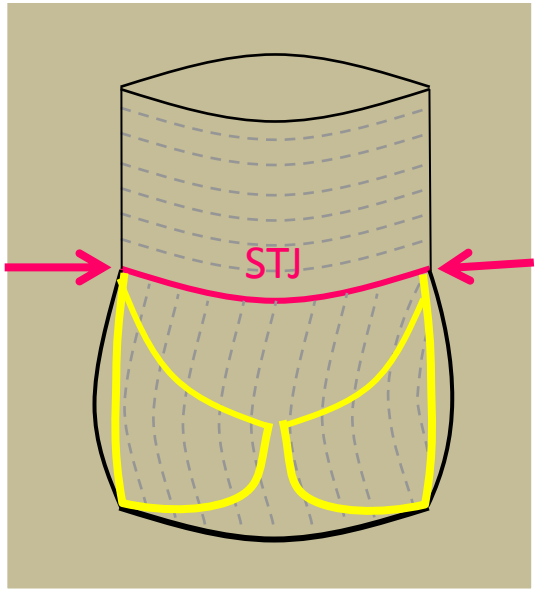
El Khoury Deep Root Dissection Maneuver



B. Valve-Sparing Reimplantation in BAV

Graft Sizing: **N/L Comm Height** Method

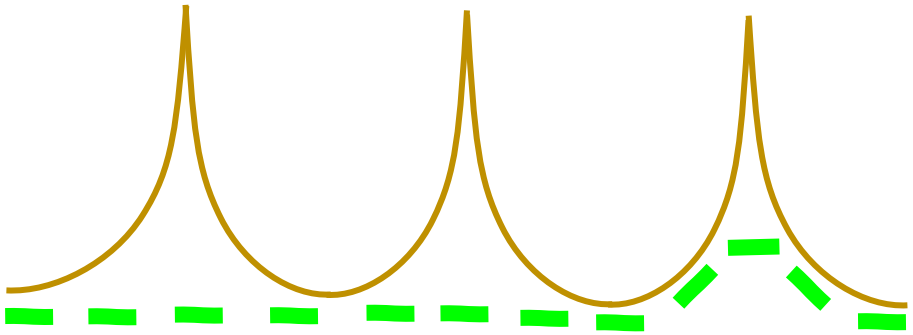




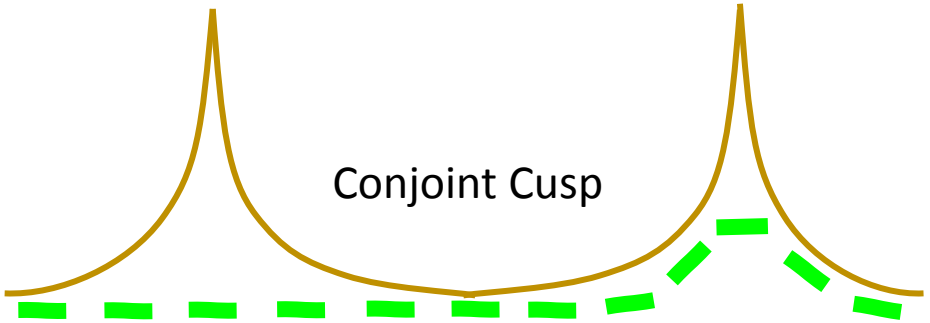
B. Valve-Sparing Reimplantation in BAV

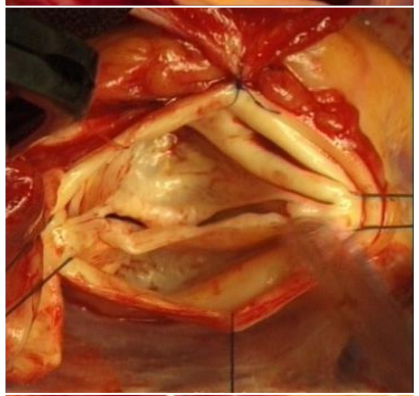
Proximal Suture Line

Tricuspid

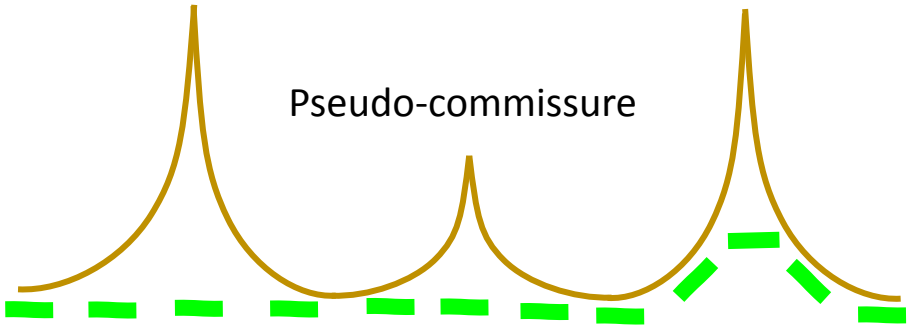


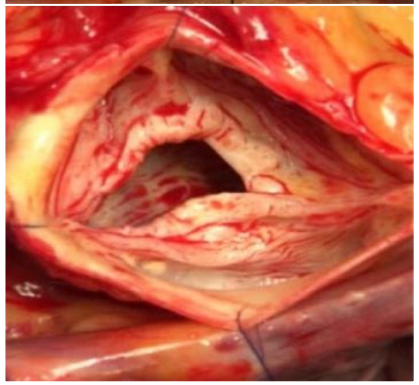
Bicuspid
Type 0





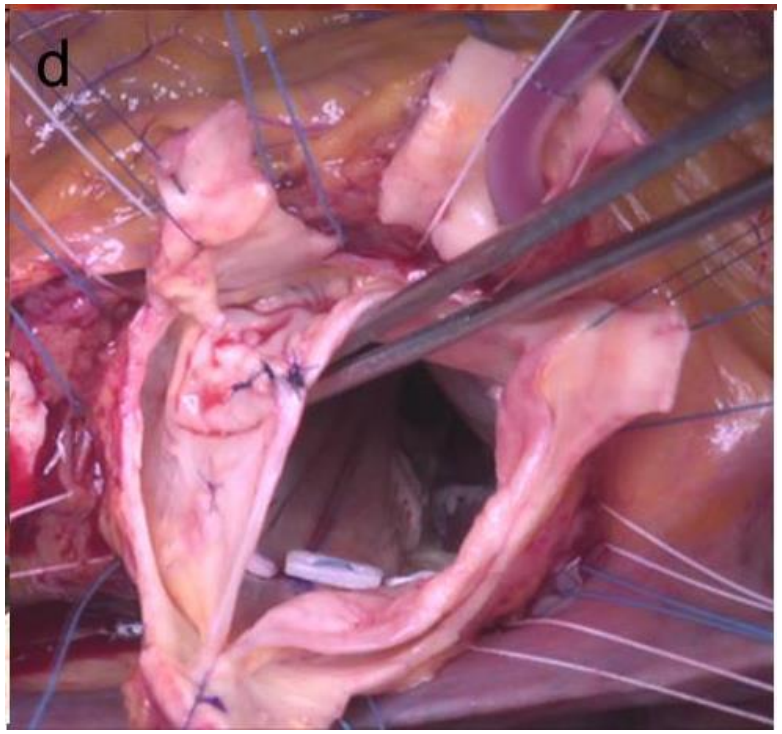
Bicuspid
Type 1

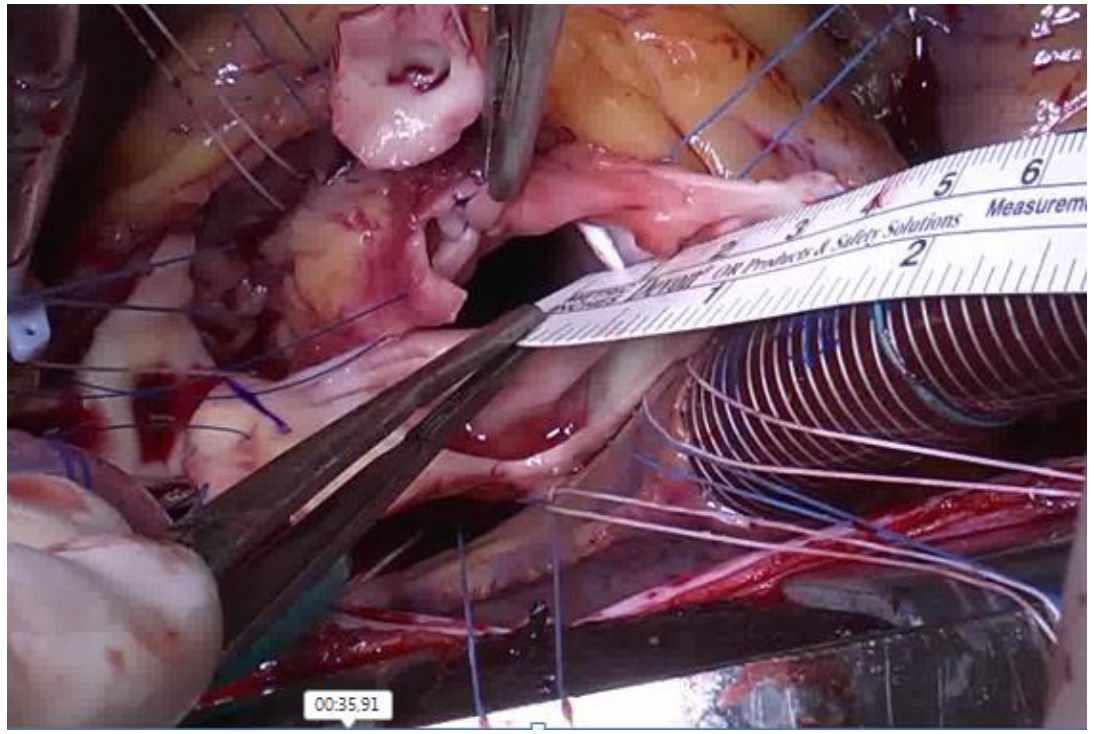




B. Valve-Sparing Reimplantation in BAV

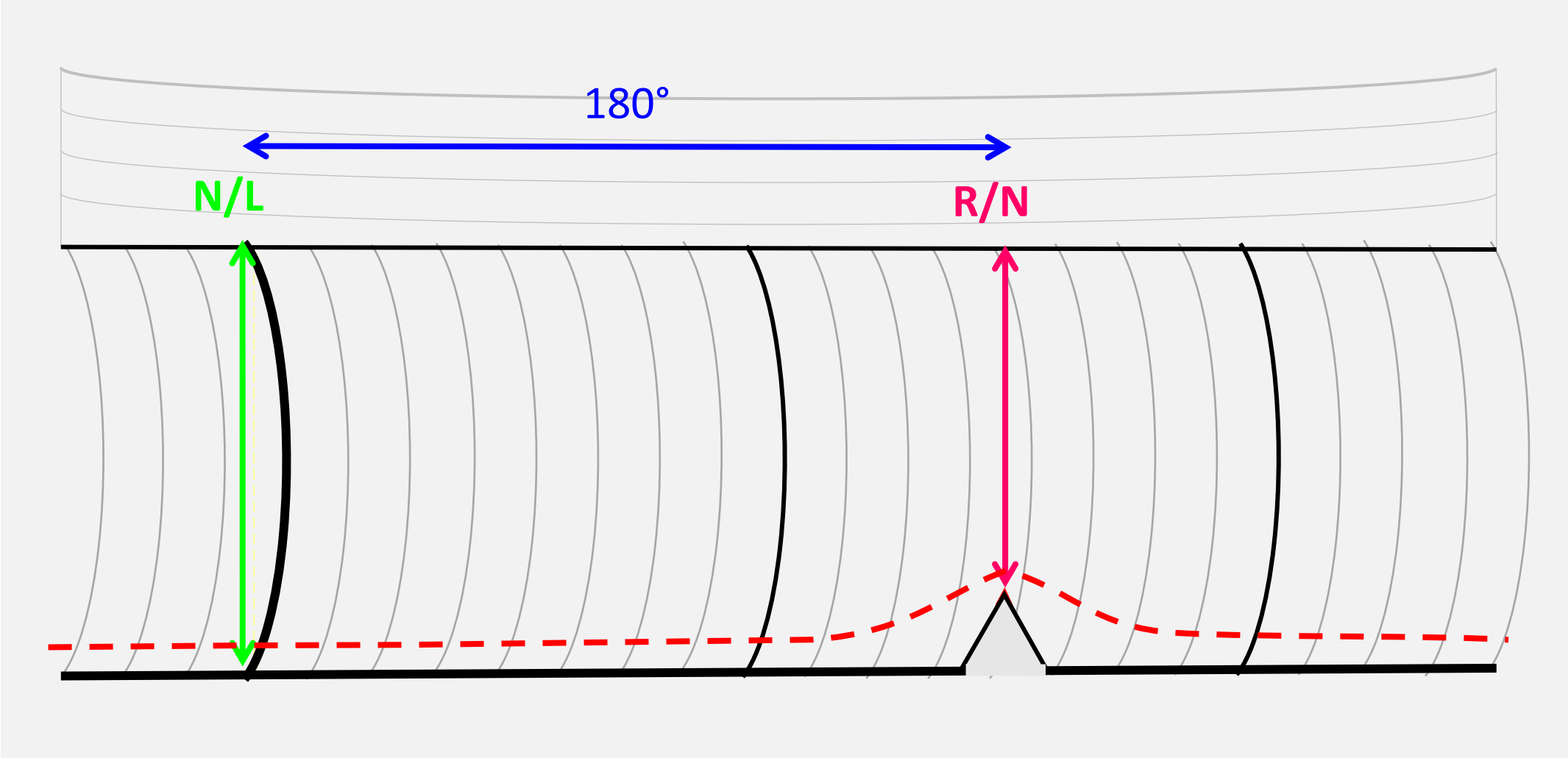
Graft Trimming to Fit External Root Symmetry





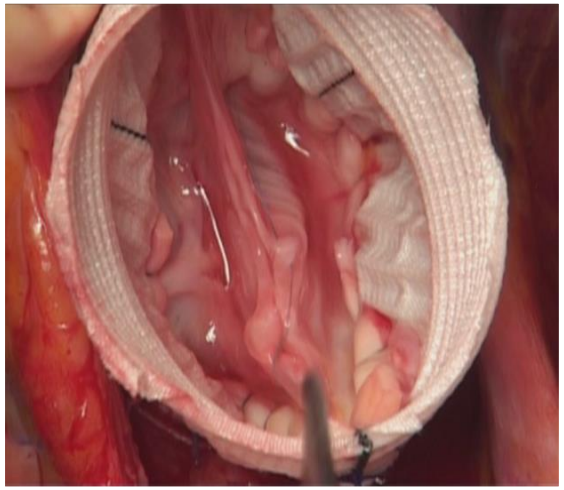
B. Valve-Sparing Reimplantation in BAV

Graft Trimming to Fit External Root Symmetry

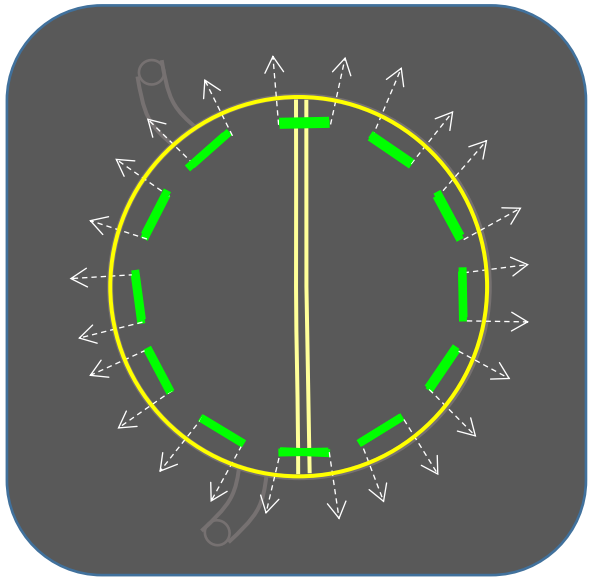


B. Valve-Sparing Reimplantation in BAV

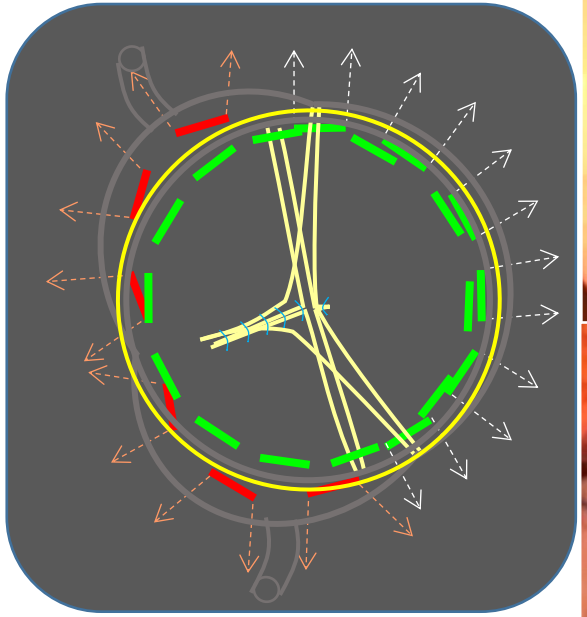
Effect of Annuloplasty on Valve Geometry

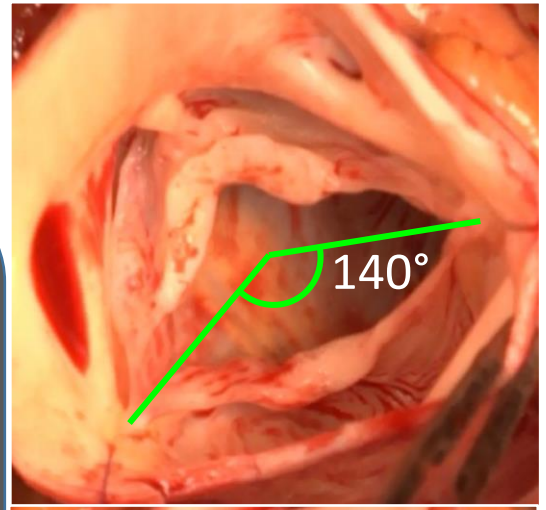


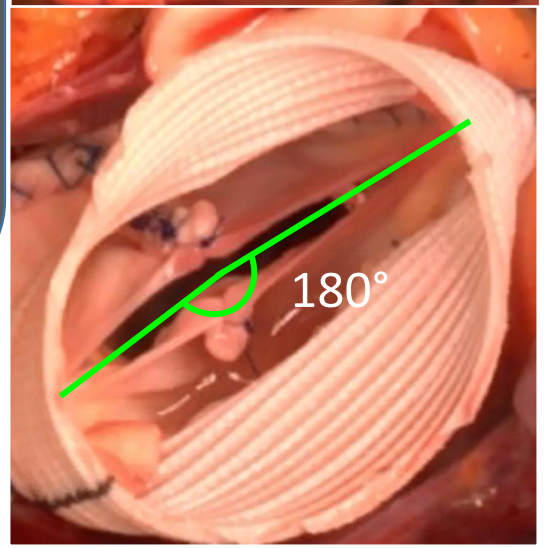
Bicuspid Type 0



Bicuspid Type 1

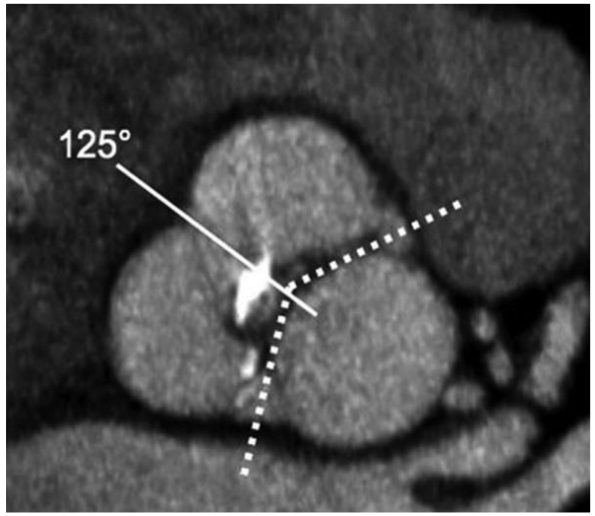


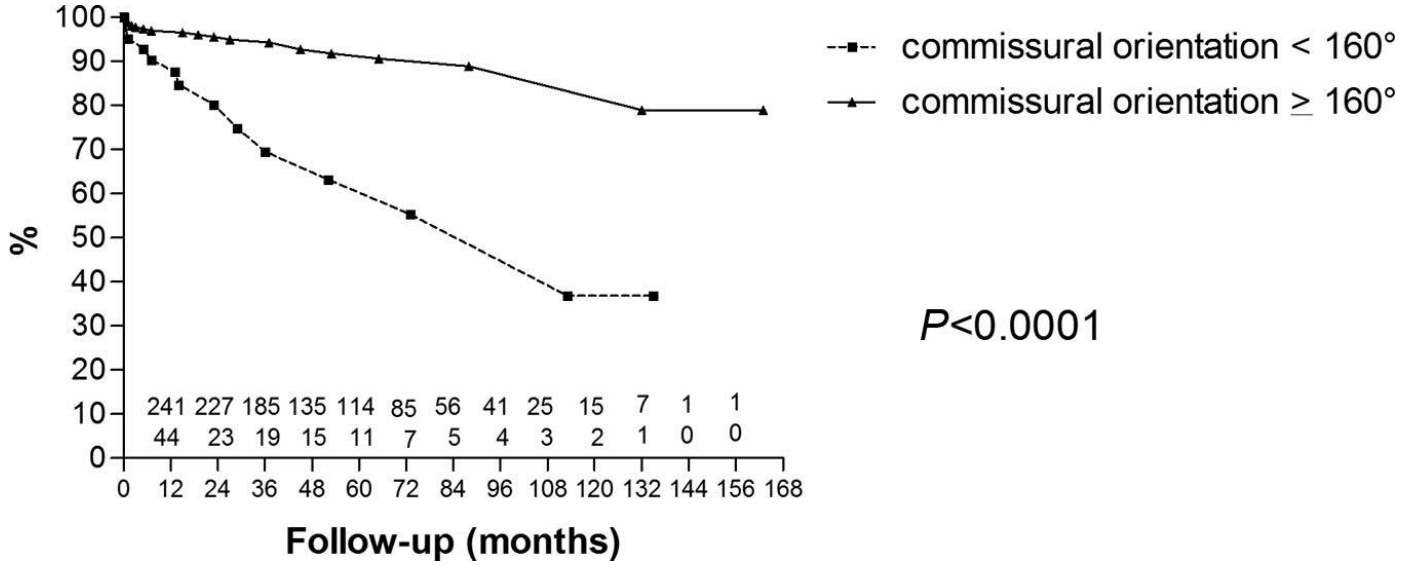




B. Valve-Sparing Reimplantation in BAV

VAJ Annuloplasty: Impact of Valve Geometry on Repair Durability

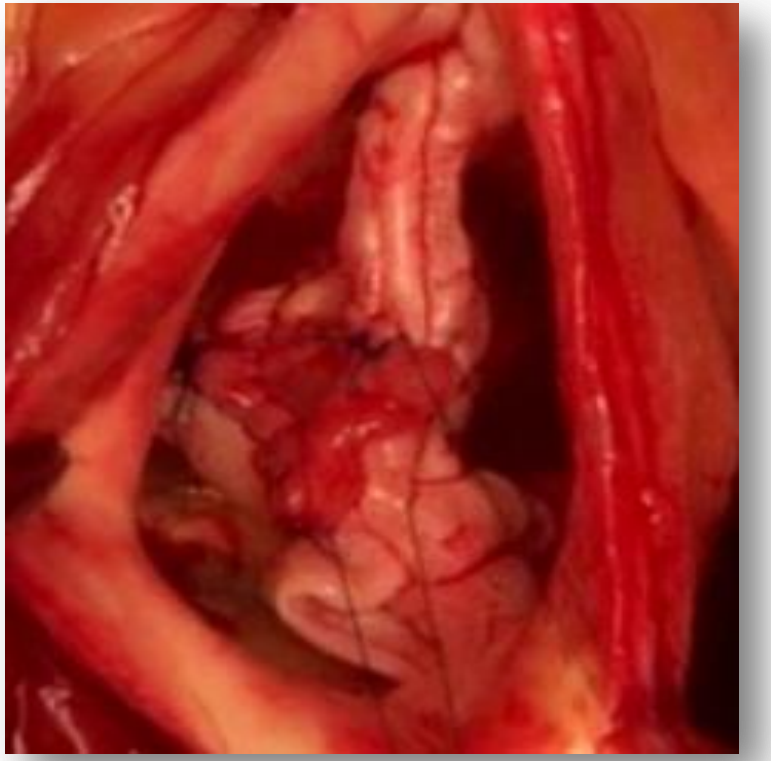




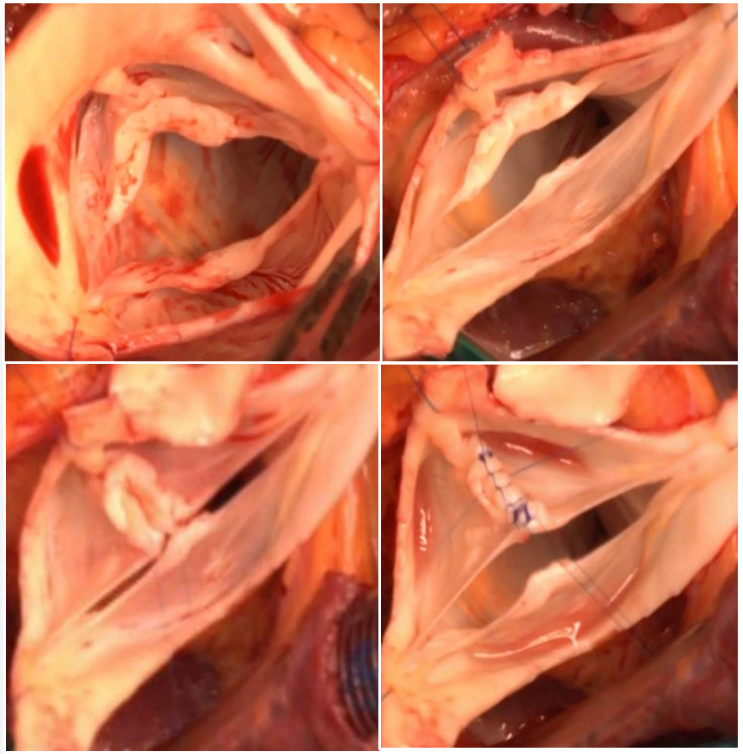
Aicher D et al. Circulation 2011

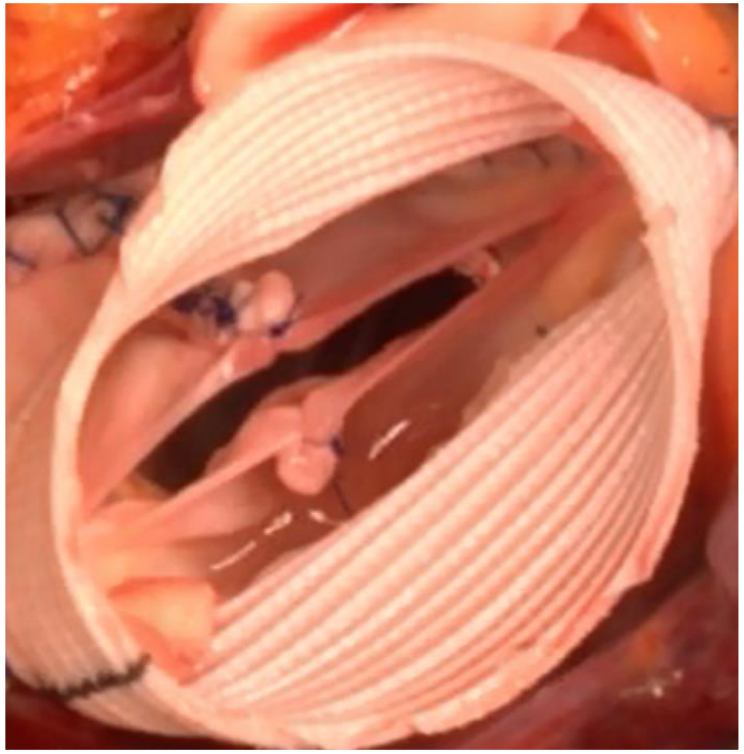
Reduce the need of patch repair for raphe closure

Patch repair



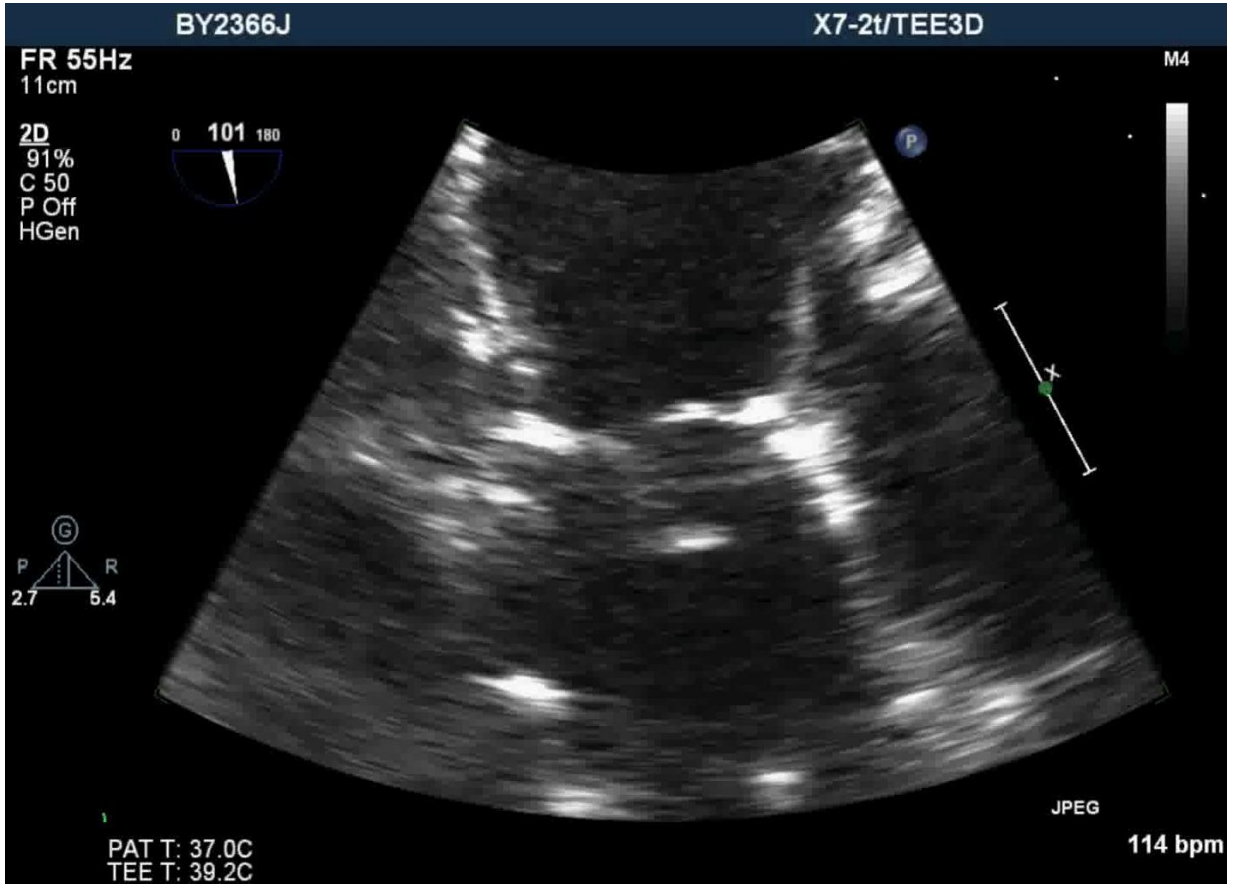
Direct closure

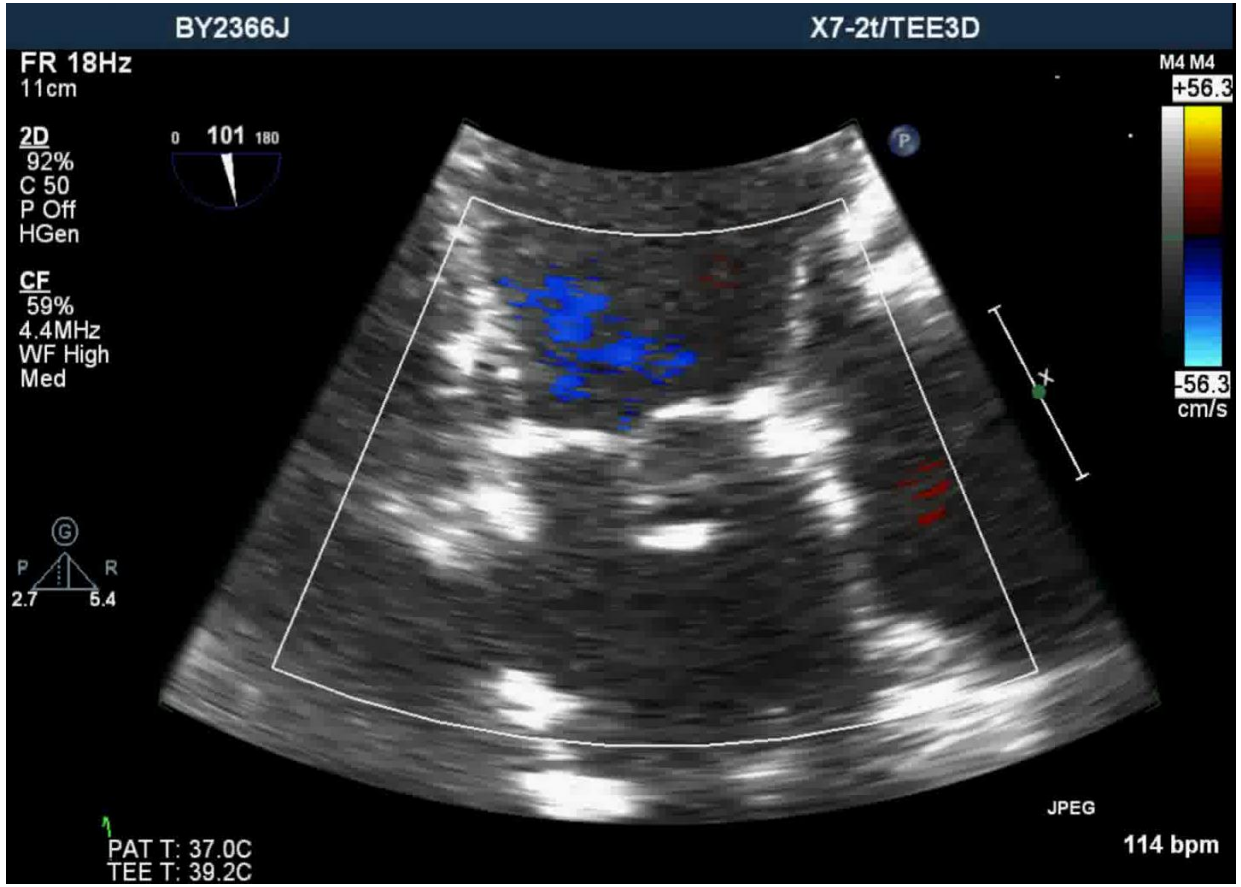




B. Valve-Sparing Reimplantation in BAV

Post-Repair TEE

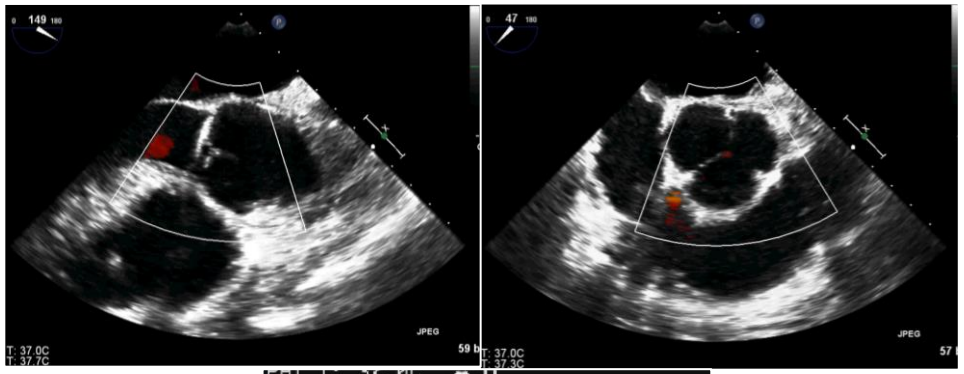




C. Principles of Aortic Valve-Sparing Reimplantation Technique

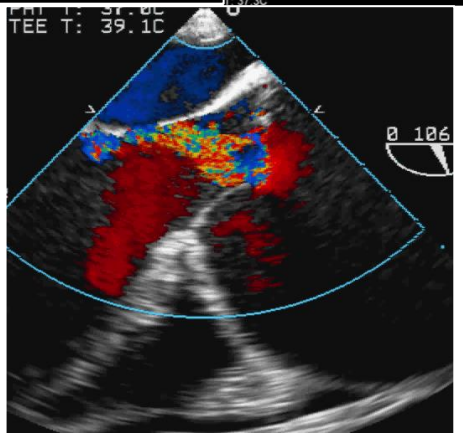
Probability of Cusp Repair

- **No AR**



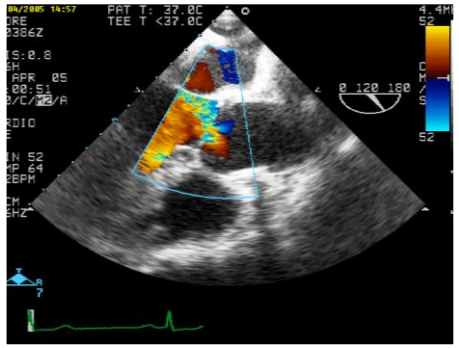
→ low ≈ 0 %

- **AR, central jet**



→ Moderate 30-50 %

- **AR, eccentric jet**



→ High ≈ 100 %

C. Principles of Aortic Valve-Sparing Reimplantation Technique

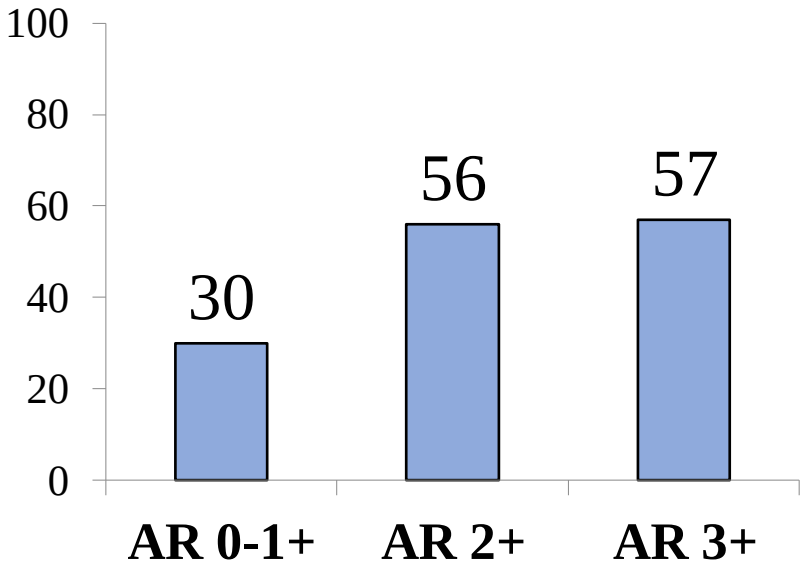
Probability of Cusp Repair

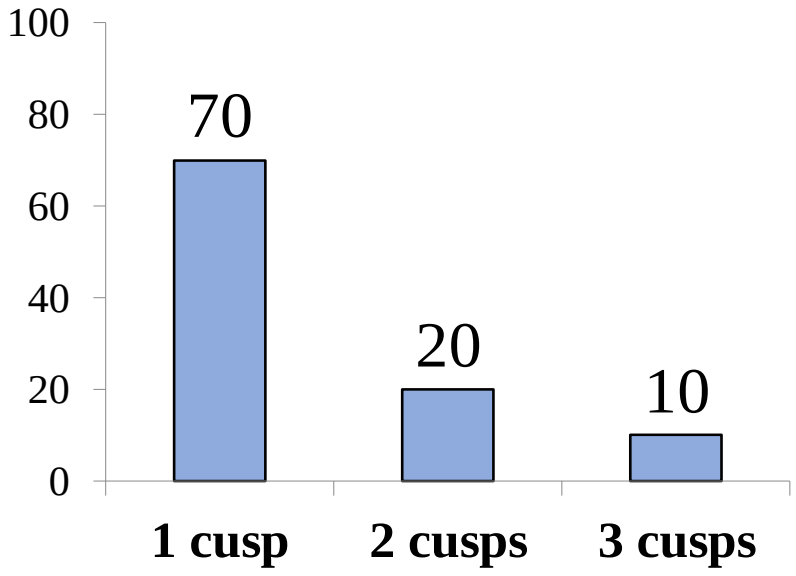
TAV

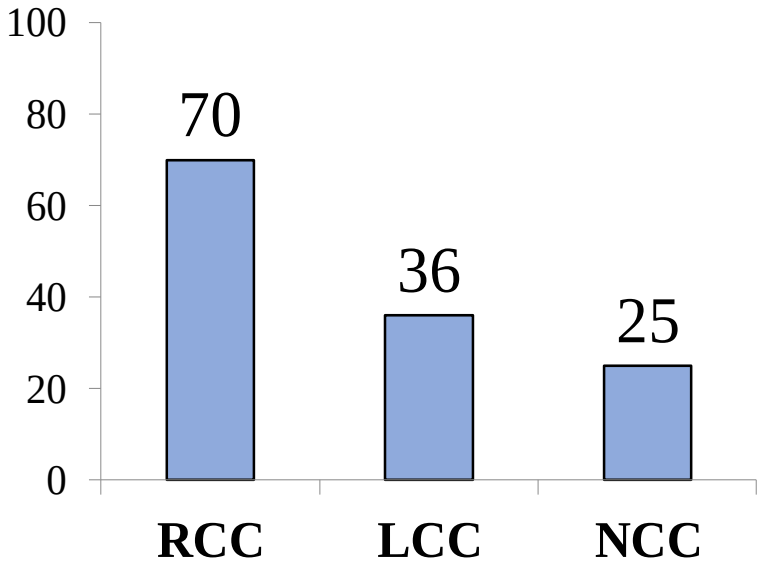
- El Khoury 60% Reimplantation
- David ≈ 60% mixte
- Schäfers ≈ 80% Remodeling

BAV

- El Khoury 95% Reimplantation
- Schäfers ≈95% Remodeling
- Miller 66% Reimplantation







C. Principles of Aortic Valve-Sparing Reimplantation Technique

Impact of Cusp Repair on Outcomes

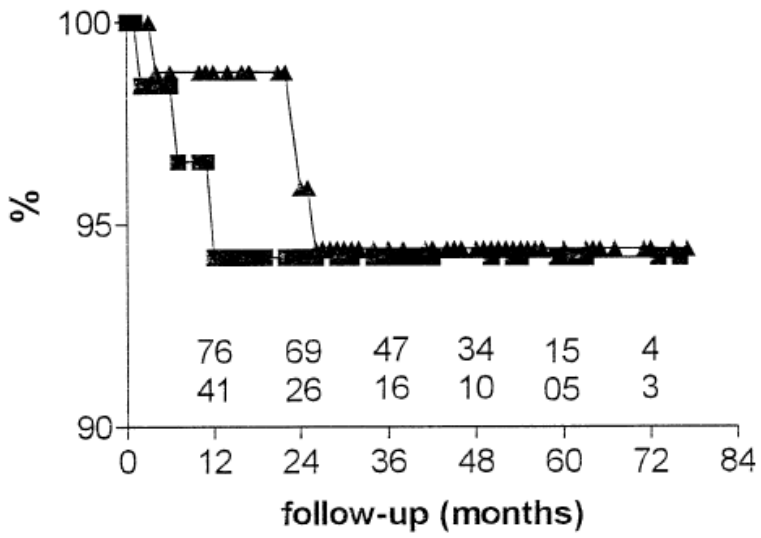
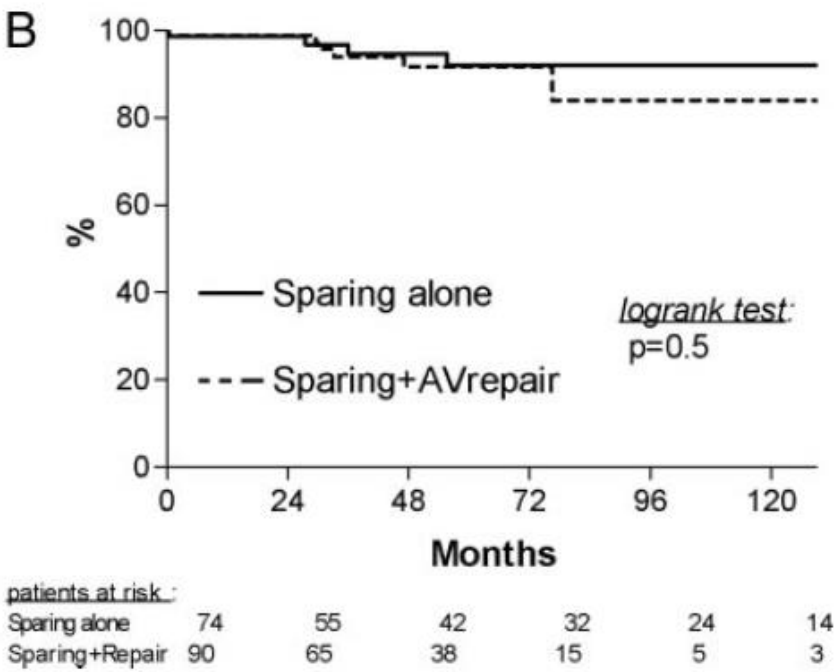


Fig 1. Actuarial freedom from aortic regurgitation greater than II after valve-preserving aortic replacement in patients with intact leaflets (triangles) or leaflet prolapse requiring correction (squares).

H.J. Schäfers ATS 2002



L. de Kerchove Circ. 2009

Cusp repair = risk factor of reoperation or recurrent AI

- *E. Lansac EJCTS 2010 (negative impact of cusp repair decrease with experience)*
- *P.P. Urbanski EJCTS 2012*

VSRR: Why to do it?

Hospital mortality

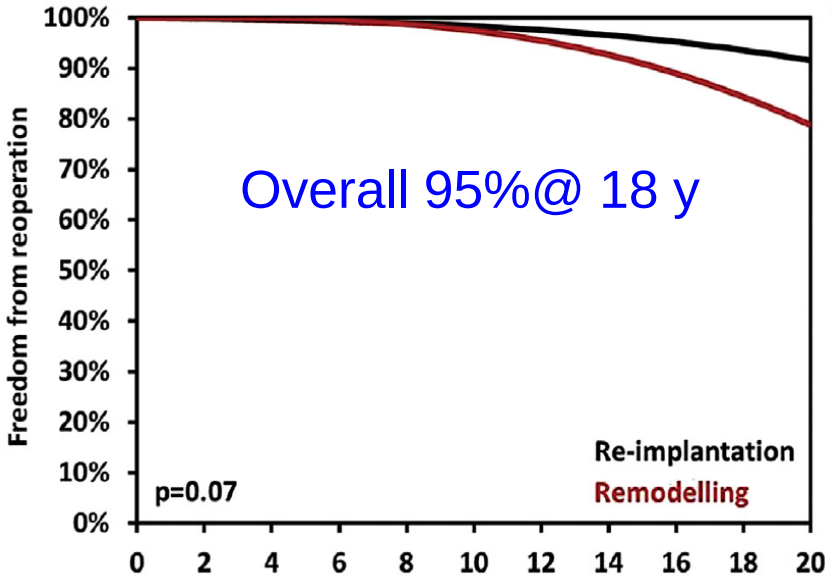
12% AAD •	1%	(4/371 pts Reimpl. & Remod.)	T. David JTCVS 2014
8% AAD •	2%	(6/747 pts Remodeling)	H-J Schäfers EJCTS 2015
10% AAD •	2%	(4777 pts Metanalysis)	*B. Arabkhani ATS 2015*
Elective •	0.3%	(1/381 pts Reimplantation)	G. El khoury, updated series 2000 – 2015
6% AAD •	0.7%	(1/146 Marfan Reimpl. & remod.)	T.David JACC 2015
4% AAD •	0%	(0/98 Marfan Reimpl. & remod.)	J. Price JTCVS 2016

1. SAFE !

VSRR: Why to do it?

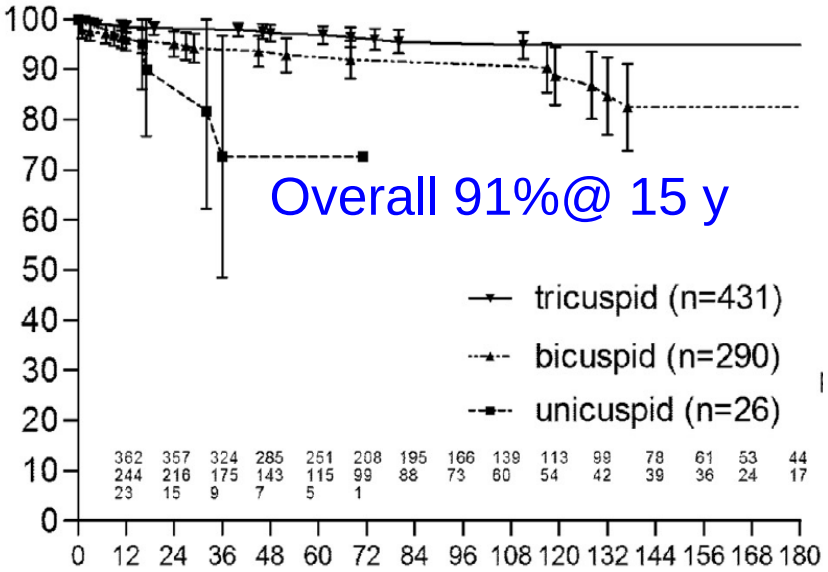
Freedom from Reoperation

Reimpl. & Remod.



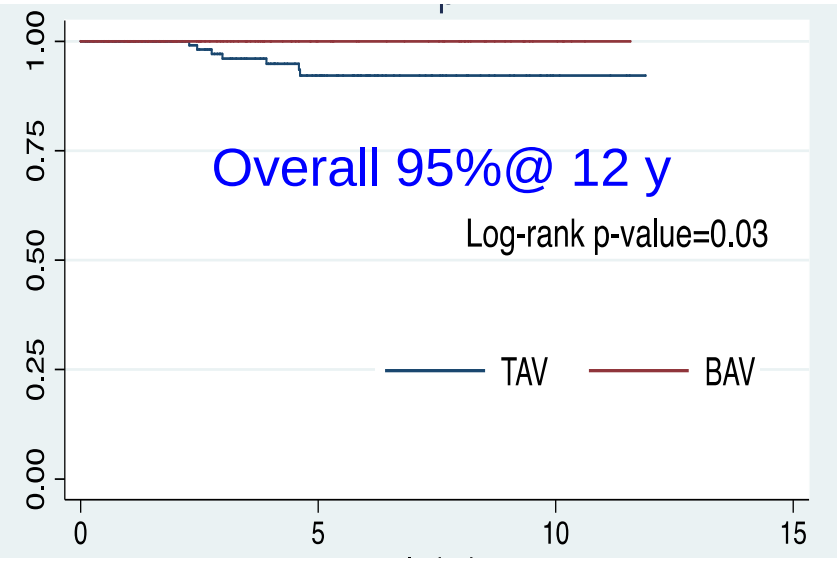
T. David JTCVS 2014

Remodeling



H-J Schafers EJCTS 2015

Reimplantation



S. Mastrobuoni STSA 2014

2. Durable !

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

Why We Dot It?

VSRR

Pooled Late Outcome Events	LOR + 95% CI
Late mortality	1.53 (1.19–1.96)
Reoperation on aortic valve	1.32 (1.0–1.74)
Hemorrhage	0.23 (0.13–0.42)
Thromboembolism	0.41 (0.22–0.77)
Endocarditis	0.23 (0.11–0.51)
MAVRE	1.66 (1.24–2.23)

0.8%

Bentall

Pooled Late Outcome Events	LOR + 95% CI
Late mortality[a]	2.02 (1.77–2.31)
Valve-related mortality	0.46 (0.36–0.59)
Root reoperation[b]	0.46 (0.36–0.59)
Valve reoperation	0.30 (0.22–0.41)
Hemorrhage	0.64 (0.47–0.87)
Thromboembolism	0.77 (0.60–1.00)
Endocarditis	0.39 (0.33–0.46)
MAVRE	2.66 (2.17–3.24)

B. Arabkhani, JJ. Takkenberg ATS 2015
A. Mookhoek, JJ. Takkenberg ATS 2016

Why do a Valve-Sparing Reimplantation Procedure?

1. SAFE
2. Durable
3. Excellent Long-Term Survival
4. Low VRE

Thank You

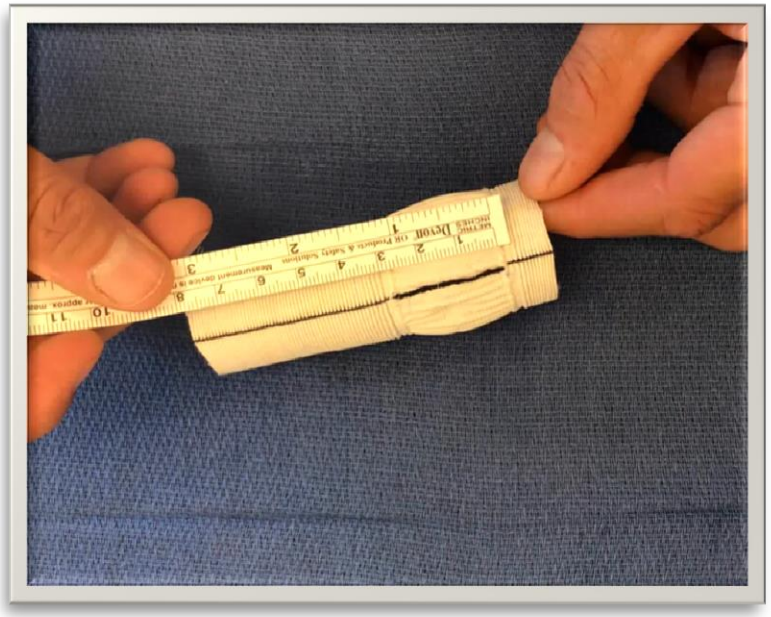
Cliniques universitaires
SAINT-LUC
UCL BRUXELLES

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

Valve-Related Complications

- 8 patients (1.9%) experienced major bleeding: 0.37% patient-year
- 10 patients (2.3%) systemic thromboembolic events: 0.73% patient-year
- 5 patients (0.4%) presented Infective Endocarditis: 0.2% patient-year

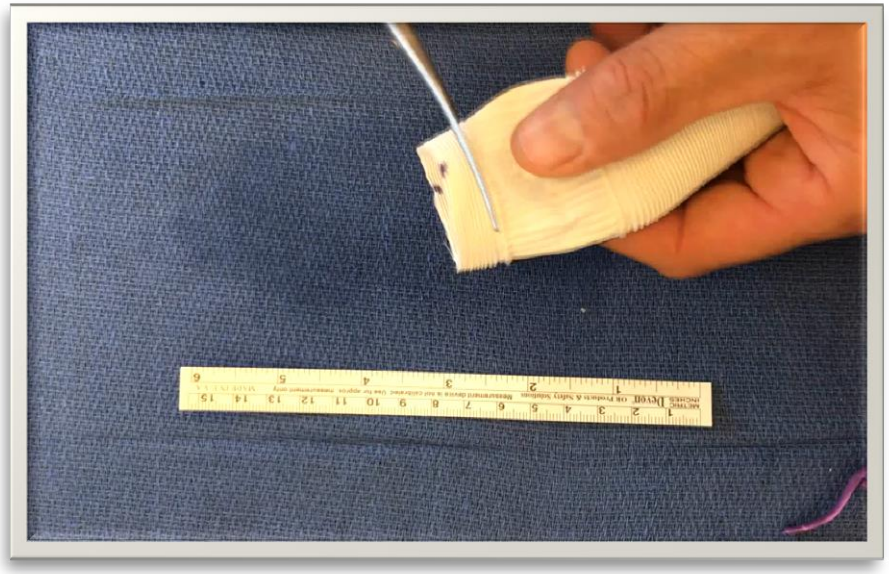
Valsalva Graft and its Advantages



Sizing of the graft:

Diameter = Height of Commissures

Non-Extensible Skirt
vs
Extensible upper portion



- Adapting proximal suture line to Deep Root Dissection
- Commissural landing at level of Valsalva STJ

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

Materials And Methods

- Between 1999-2017, 923 patients underwent AV repair at St. Luc' s Hospital (Brussels, Belgium); **440 patients** (47.7%) were treated with VSRR and are the Study Cohort;
- Patients were divided into 3 groups according to the indication for surgery:
  - Root aneurysm without AR (**Conventional Indication**)

    Group 1 = 139 patients (31.6%)
  - Root aneurysm with significant AR (**"debated" indication**)

    Group 2 = 212 patients (48.2%)
  - Isolated AR (**non-conventional indication**)

    Group 3 = 76 patients (17.3%)
  - Further 12 patients (2.7%) presented with acute type-A aortic dissection

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

Demographics

	Aneurysm n=139	Aneurysm + AR n=212	Isolated AR n=76	*p*
Mean age ± SD (years)	47±14	51±15	42±13	0.05
Male, n (%)	128 (92.1)	191 (90.1)	70 (92.1)	0.7
Bicuspid AV, n (%)	49 (35.2)	76 (55.9)	52 (68.4)	<0.001
Grade of Aortic regurgitation, n (%)				
0-1	139 (100)	0	0	<0.001
2		70 (33.0)	6 (7.9)	
3		103 (48.6)	58 (76.3)	
4		39 (18.4)	12 (15.8)	
NYHA Functional Class (%):				
I	112 (80.6)	105 (93.7)	41 (53.9)	<0.001
II	23 (16.5)	79 (37.3)	30 (39.5)	
III	3 (2.2)	28 (13.2)	5 (6.6)	
IV	1 (0.7)	0	0	
LV Ejection Fraction				
≥50%	132 (95)	175 (82.5)	69 (90.8)	0.03
31-49	7 (5)	33 (15.6)	7 (9.2)	
≤30	0	4 (1.9)	0	
LVEDD (mm), mean ± SD	53±5	61±8	63±7	0.02
VAJ (mm), mean ± SD	27 ± 3*	28 ± 4	29 ± 4*	0.007*
Previous Cardiac Surgery, n (%)	3 (2.1)	4 (1.9)	5 (6.6)	0.09
Connective Tissue Disorder, n (%)	19 (13.7)	14 (6.6)	1 (1.3)	0.004

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

Intra-Operative and Post-Operative Data

	Aneurysm n=139	Aneurysm + AR n=212	Isolated AR n=76	*p*
Graft size mm, median	30	30	30	0.3
CPB Time (min) mean ± SD)	145±35	150±34	151±26	0.6
Concomitant Procedures, n(%): Mitral Valve Repair Hemi-arch CABG	37 (26.6) 5 (5.0) 4 (2.9) 18 (0.7)	54 (25.5) 13 (6.1) 12 (5.6) 9 (4.2)	13 (17.1) 6 (7.9) 0 4 (5.2)	0.2
Cusp Repair Patch	76 (54.7) 1 (0.7)	170 (80.2) 15 (7.1)	74 (97.4) 4 (5.2)	<0.001 0.02
Reopening for bleeding, n (%)	21 (15.1)	23 (10.9)	8 (10.5)	0.4
Permanent Pacemaker Insertion, n (%)	9 (6.5)	7 (3.3)	5 (6.6)	0.3
30-days death	1 (0.7)	0	0	0.3
Lost to Follow-up, n(%)	3 (2.1)	6 (2.8)	6 (7.9)	0.07
Follow-up years, Median (IQR)	4.7 (2-8.5)	5.5 (2-9.7)	3.1 (1.4-5.8)	

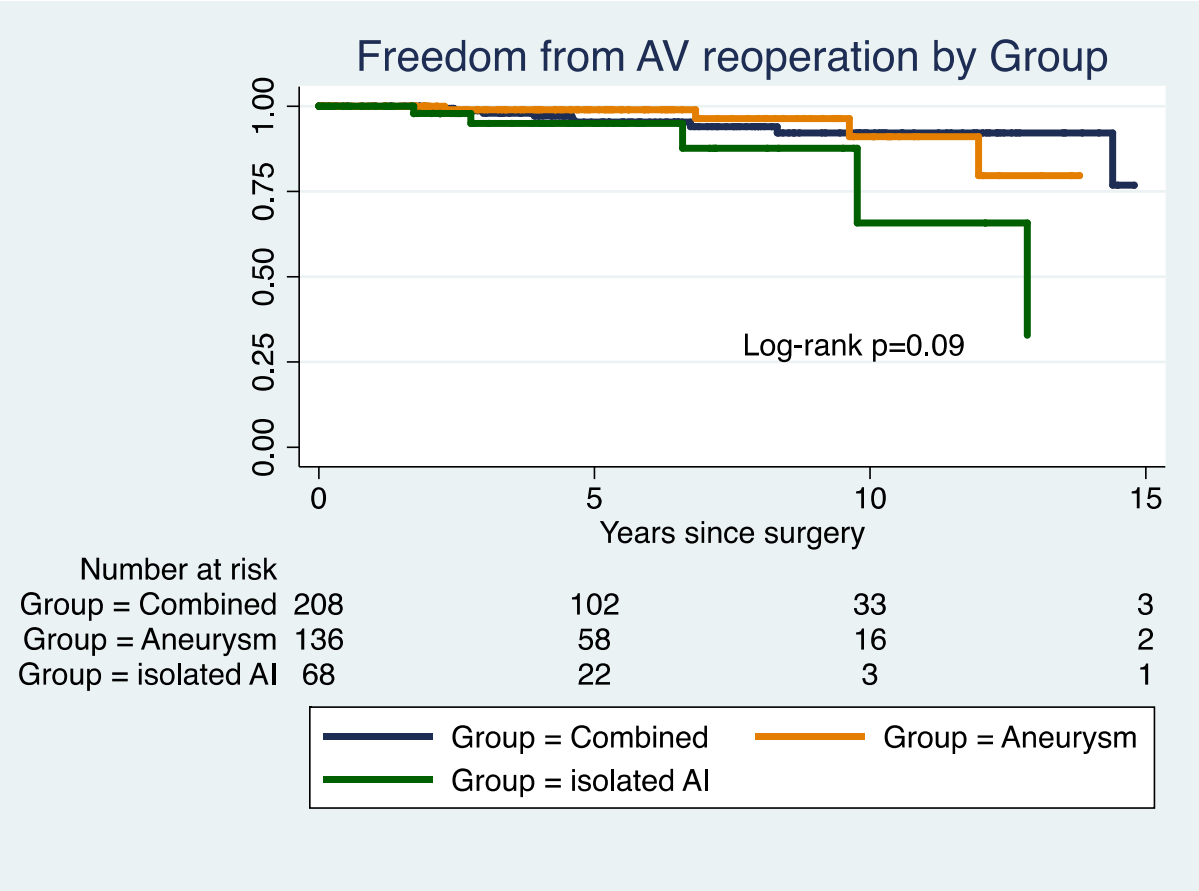
D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

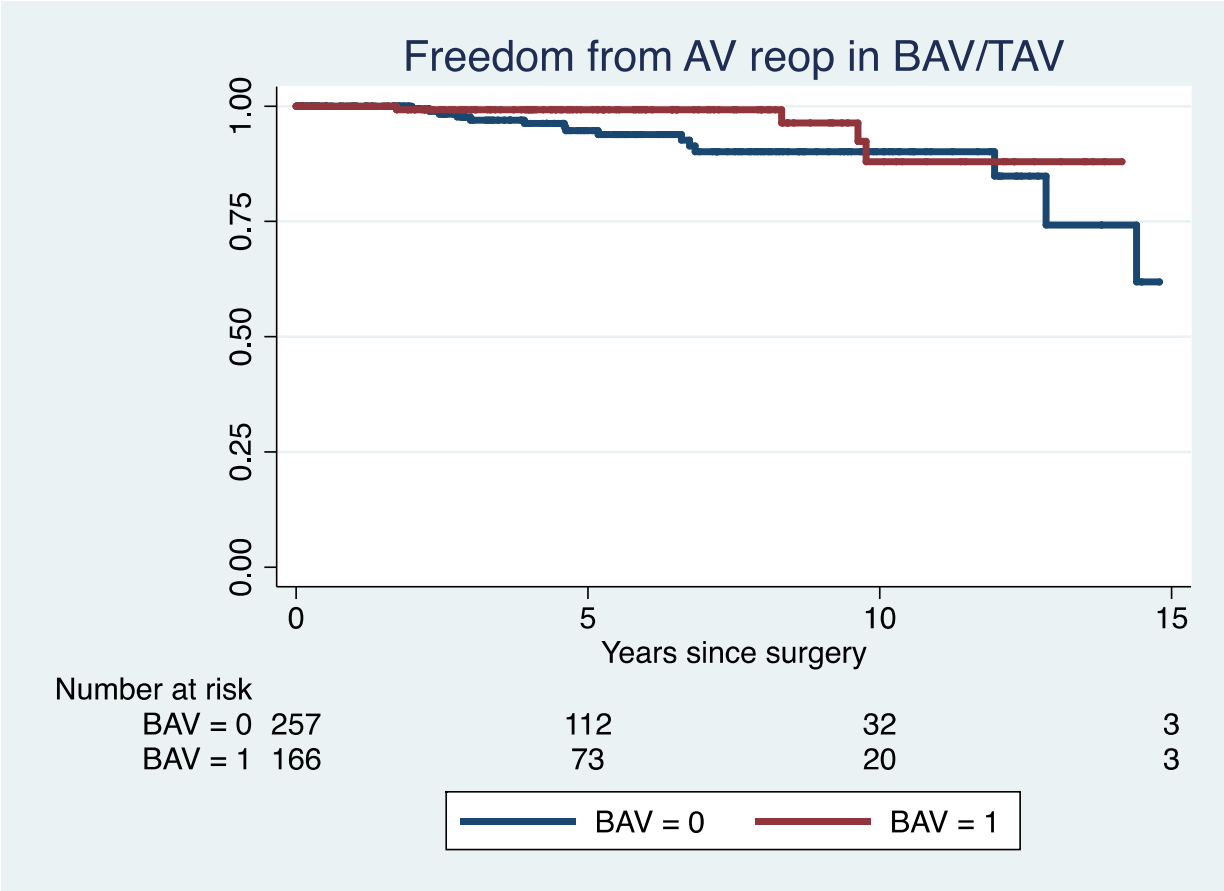
Reoperation

- Perioperative mortality: 0%
- 1 early (during the same admission) AV reoperation (underwent re-repair)
- 17 late AV reoperation (2.6%); linearized rate of 0.6% per patient-year
- Indications for re-intervention:
  - 8 recurrent Severe AI (3 AV replacement, 5 re-repair)
  - 3 severe AS (3 replacement)
  - 4 Infective Endocarditis (4 replacement)
  - 2 mixed stenosis and regurgitation (2 replacement)

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

Freedom from Reoperation



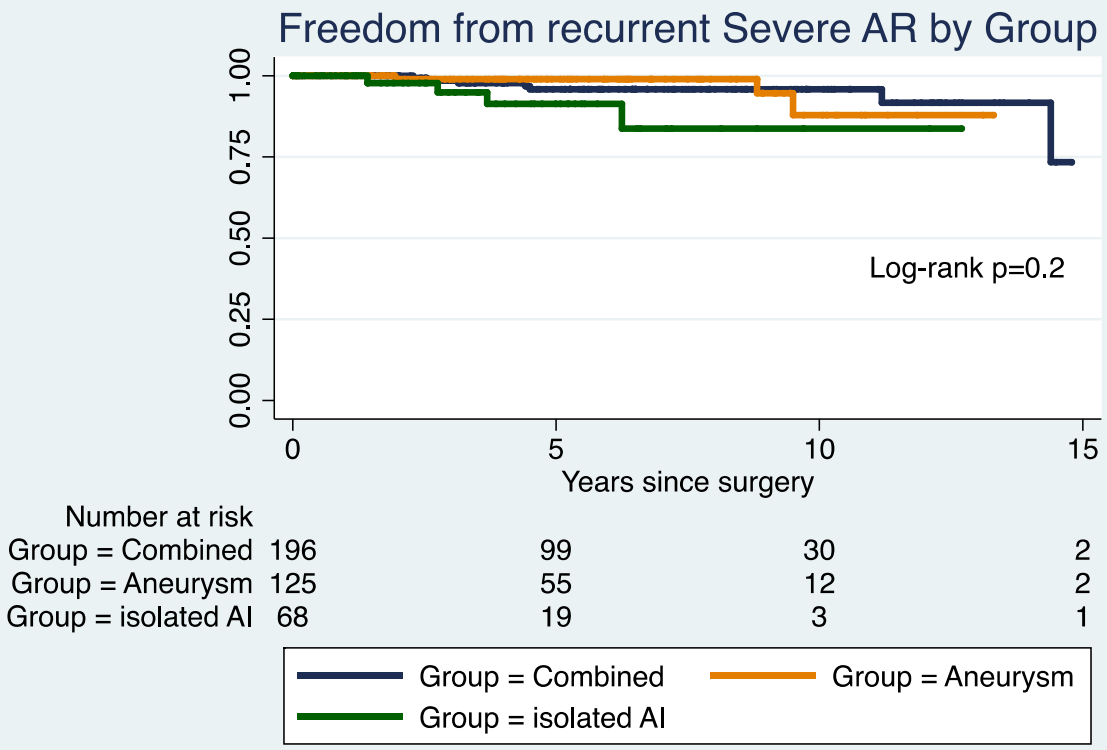


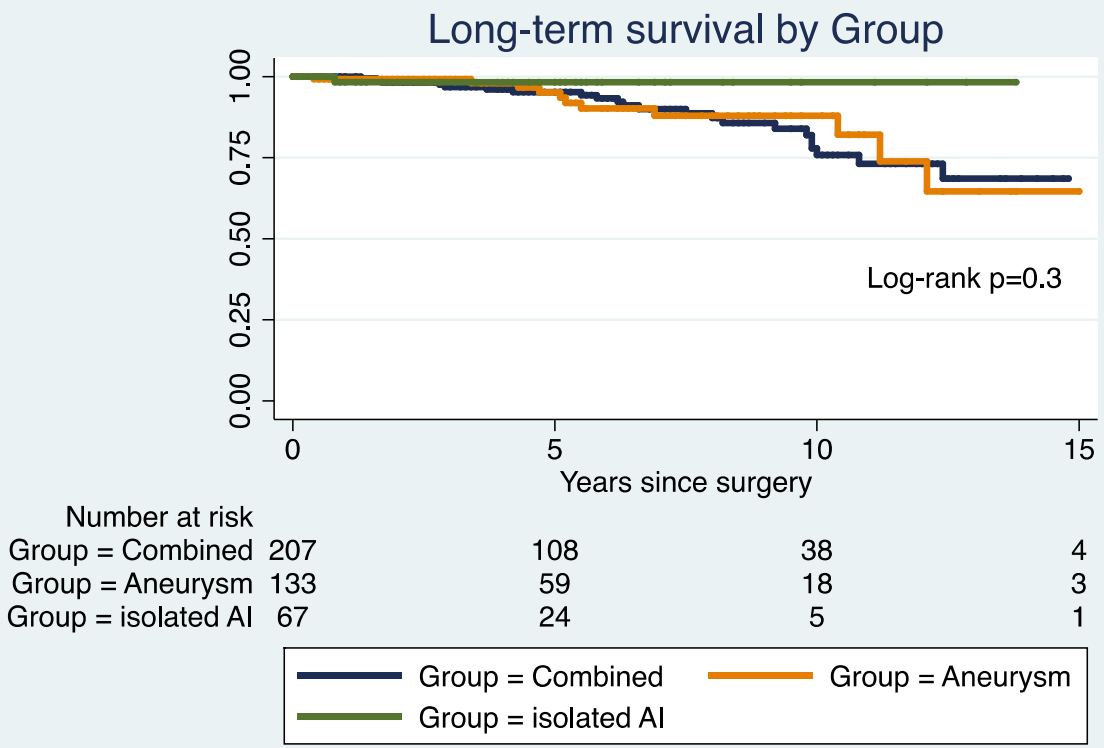
Late AV re-operation: 4 in Group Aneurysm (3%), 9 in Group Aneurysm+AR (6.6%), 5 in Group isolated AR (7.1%)

Late AV re-operation: 4 in BAV (2.2%), 15 in TAV (5.7%)

D. Results of Valve-Sparing Reimplantation Technique (Brussels Experience)

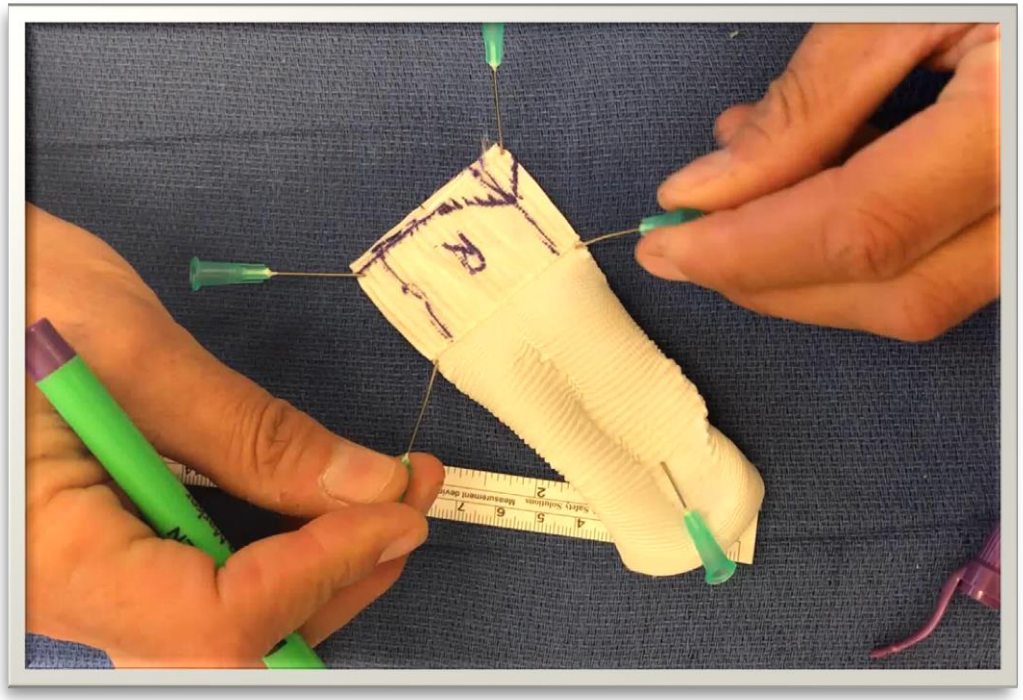
Freedom from AR and Long-Term Survival



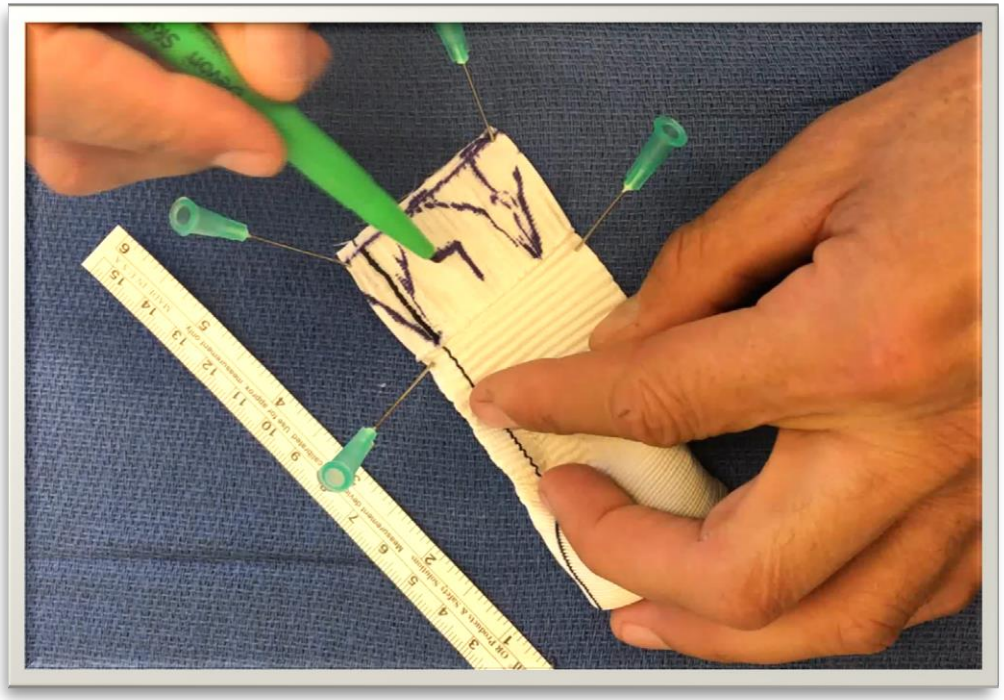


- 36 late deaths (8.5%); linearized mortality rate of 1.6% per patient-year
  - Overall survival at 10-year: 81% (95% CI: 72.8-87.0)
  - 10 cardiac-related
  - 26 non-cardiac causes

Valsalva Graft and its Advantages



Inextensibility of the skirt = Advantage for sinus creation



Flexibility for Coronary Reimplantation

Advantage in non-anevrysmal roots

B. Valve-Sparing Reimplantation in BAV

Graft Trimming to Fit External Root Symmetry