XXVIII Giornate Cardiologiche Torinesi
"ADVANCES IN CARDIAC ARRHYTHMIAS AND GREAT INNOVATIONS IN CARDIOLOGY"
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Centro Congressi Unione Industriale

Contemporary Approach to Bicuspid Aortic Valve

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Prevalence of BAV

Systematic echocardiographic screening in children:

- 0.6-0.8% in males

- 0.2% in females

- 1-2% general population

Estimations in the USA

– Prevalence 1.4%

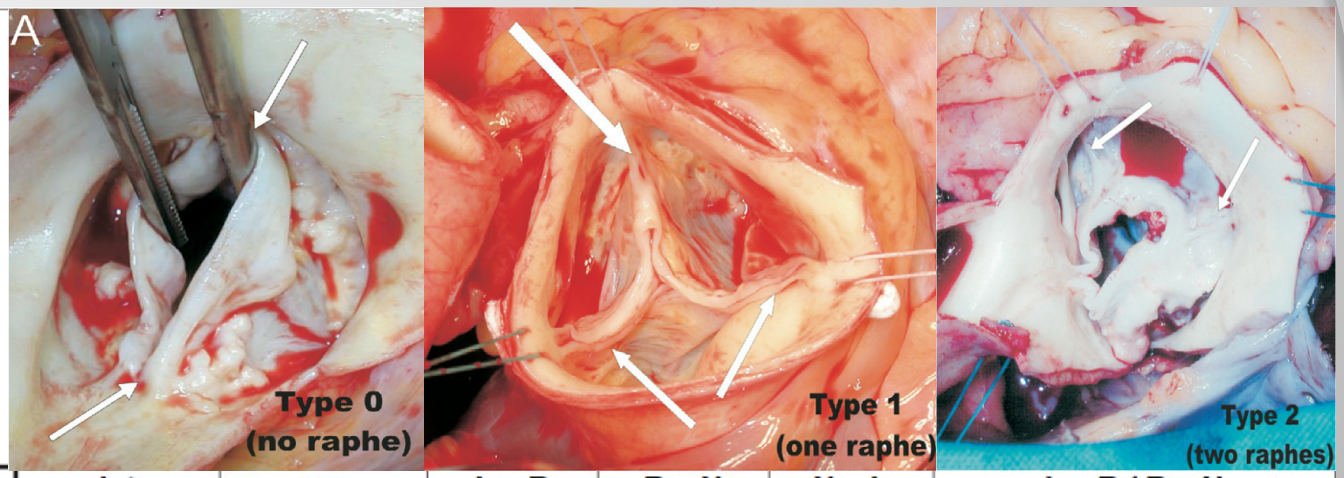
(Tutar et al. Am Heart J 2005;150:513-5)
(Nistri et al. Am J Cardiol 2005:96:718-21)

– Incidence of new cases estimated at 54 800 per year in the USA

(AHA Heart Disease and Stroke Statistics--2012 Update Circulation 2012; 125:e2-e220)

A classification system for the bicuspid aortic valve from 304 surgical specimens

Hans-H. Sievers, MD, and Claudia Schmidtke, MD, MBA



main category: number of raphes							
1. subcategory: spatial position of cusps in Type 0 and raphes in Types 1 and 2		lat 13 (4)	ap 7 (2)	L – R 216 (71)	R – N 45 (15)	N – L 8 (3)	L – R / R – N 14 (5)
2. subcategory:							
VALVULAR FUNCTION	I	6 (2)	1 (0.3)	79 (26)	22 (7)	3 (1)	6 (2)
	S	7 (2)	5 (2)	119 (39)	15 (5)	3 (1)	6 (2)
	B (I + S)		1 (0.3)	15 (5)	7 (2)	2 (1)	2 (1)
	No			3 (1)	1 (0.3)		

Aortopathy

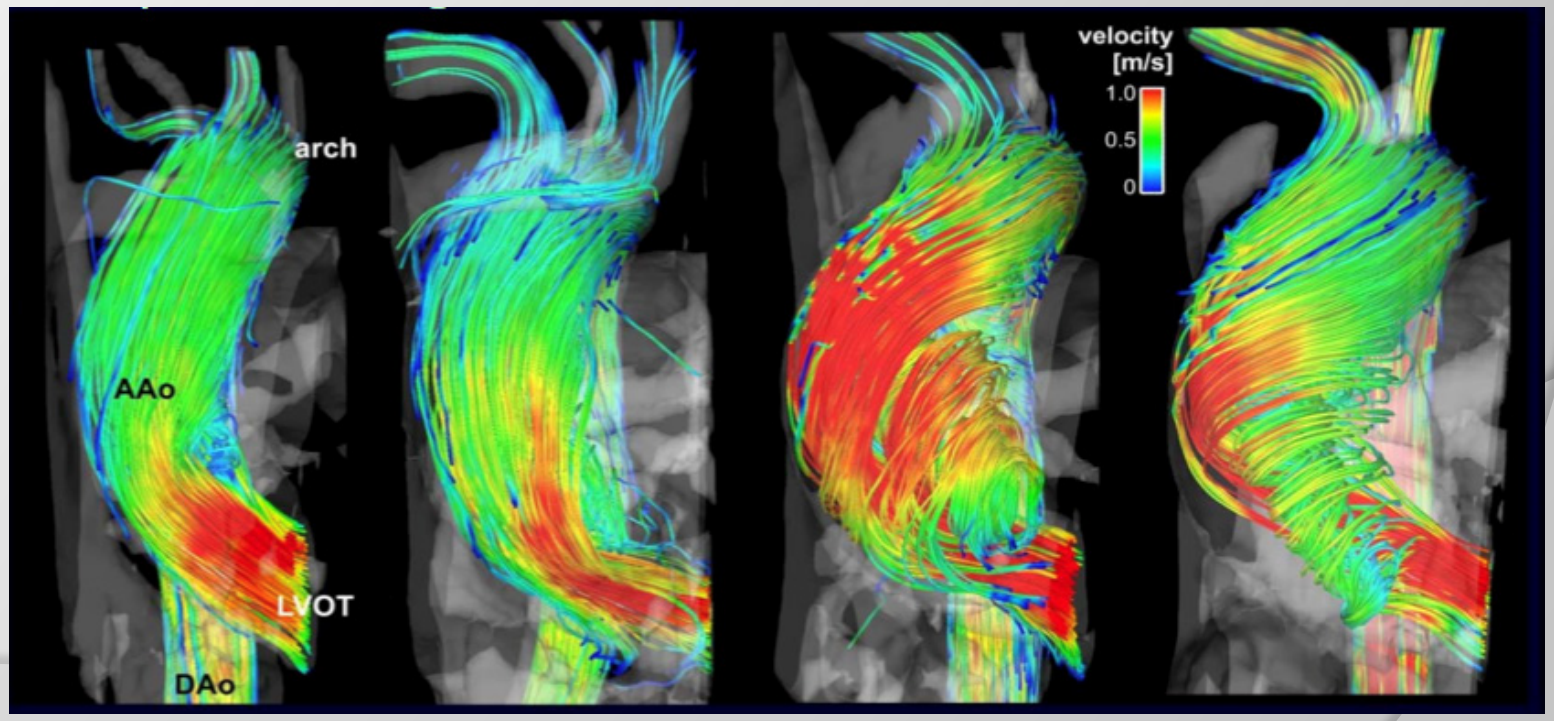
Independent risk factor

1. Dissection
2. Degeneration of aortic media

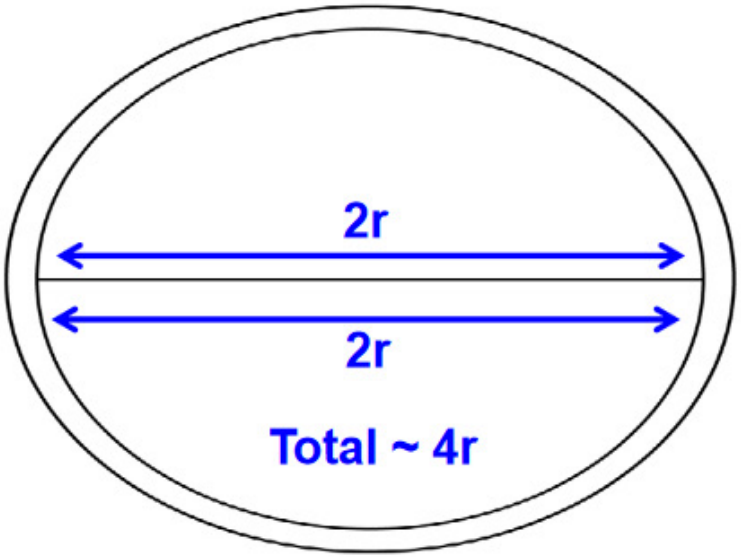
Mechanism unknown

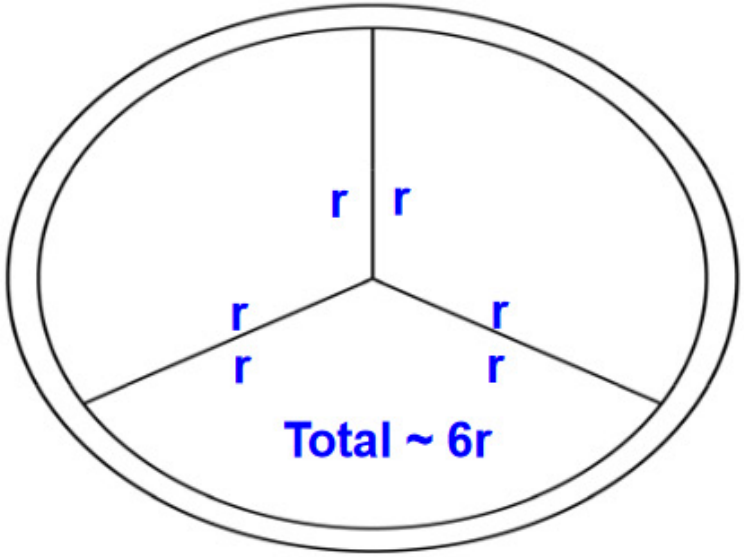
1. Aortic dilatation and aneurysm
2. Post-stenotic dilatationformation

Healthy volunteer age/size control RL-BAV RN-BAV



Circumference = 2 π r $\approx$ 6 r





Pi = circumference/diameter = 3.14 . . . (roughly 3)

Different Scenarios

1. *BAV with AR and relatively normal Root diameters*
2. *BAV with AR and Root and/or Ascending Aorta Dilatation*
3. *BAV with AS and normal Root/Ascending Aorta*
4. *BAV with AS and Root and/or Ascending Aorta Dilatation*

Problem: different theraputic procedures for each presentation??

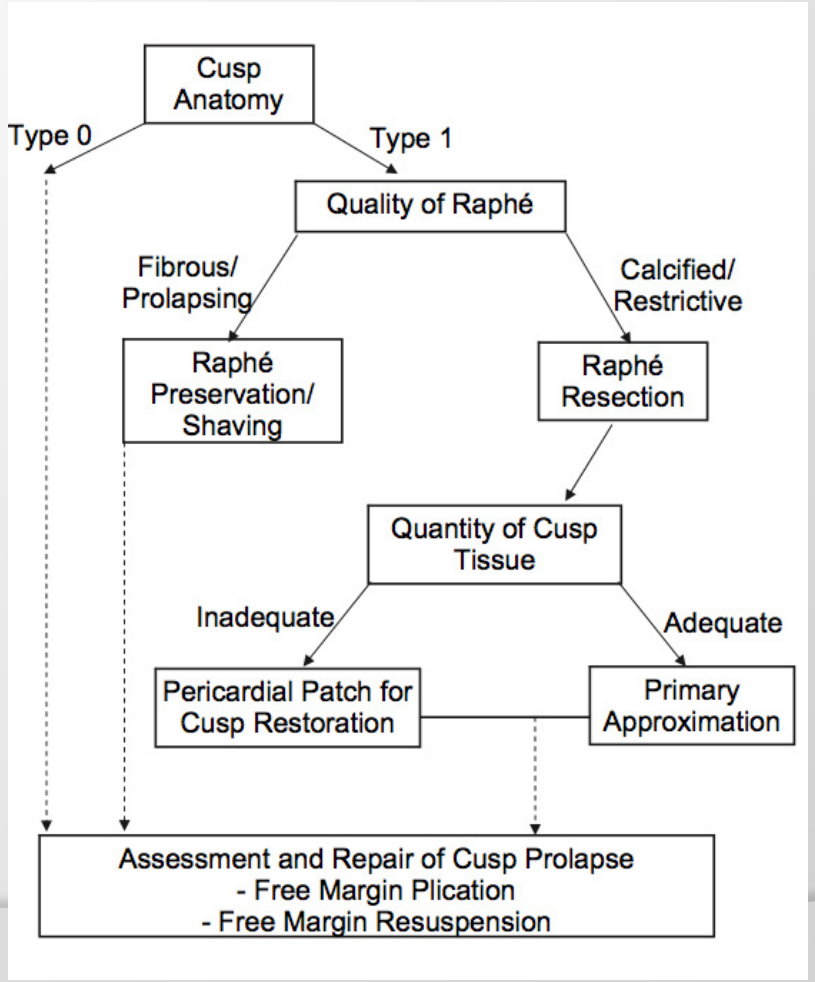
Essentials of Leaflet Repair

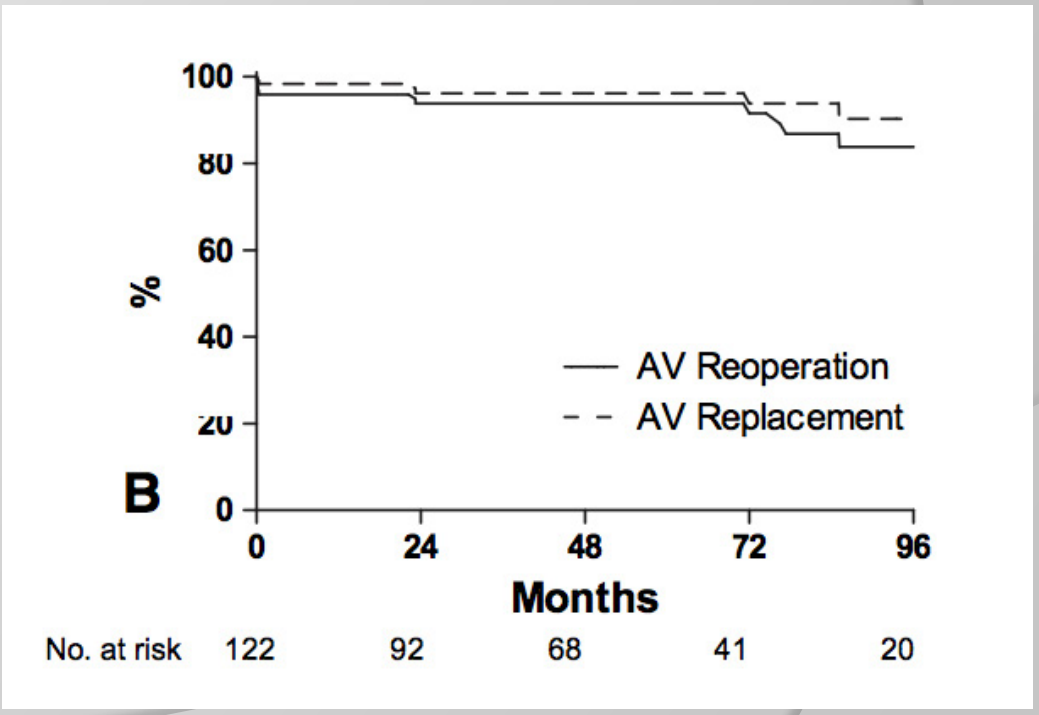
1. *Stabilize or If Necessary Reduce the Annulus*
2. *Debridement of Leaflet to Improve Mobility*
3. *Free Margin Equalization*
4. *Optimize Leaflet Coaptation above the Annulus (Improve the effective height of the leaflet)*

Repair of regurgitant bicuspid aortic valves: A systematic approach

Munir Boodhwani, MD, MMSc,[a,b,] Laurent de Kerchove, MD,[a] David Glineur, MD,[a] Jean Rubay, MD,[a] Jean-Louis Vanoverschelde, MD,[a] Philippe Noirhomme, MD,[a] and Gebrine El Khoury, MD[a]

(J Thorac Cardiovasc Surg 2010;140:276-84)





Basic Repair Techniques

Basic Repair Techniques

Plication

- Restore prolapsed leaflet
- More durable than resection
- 5-0 prolene or Gortex

Free margin resuspension

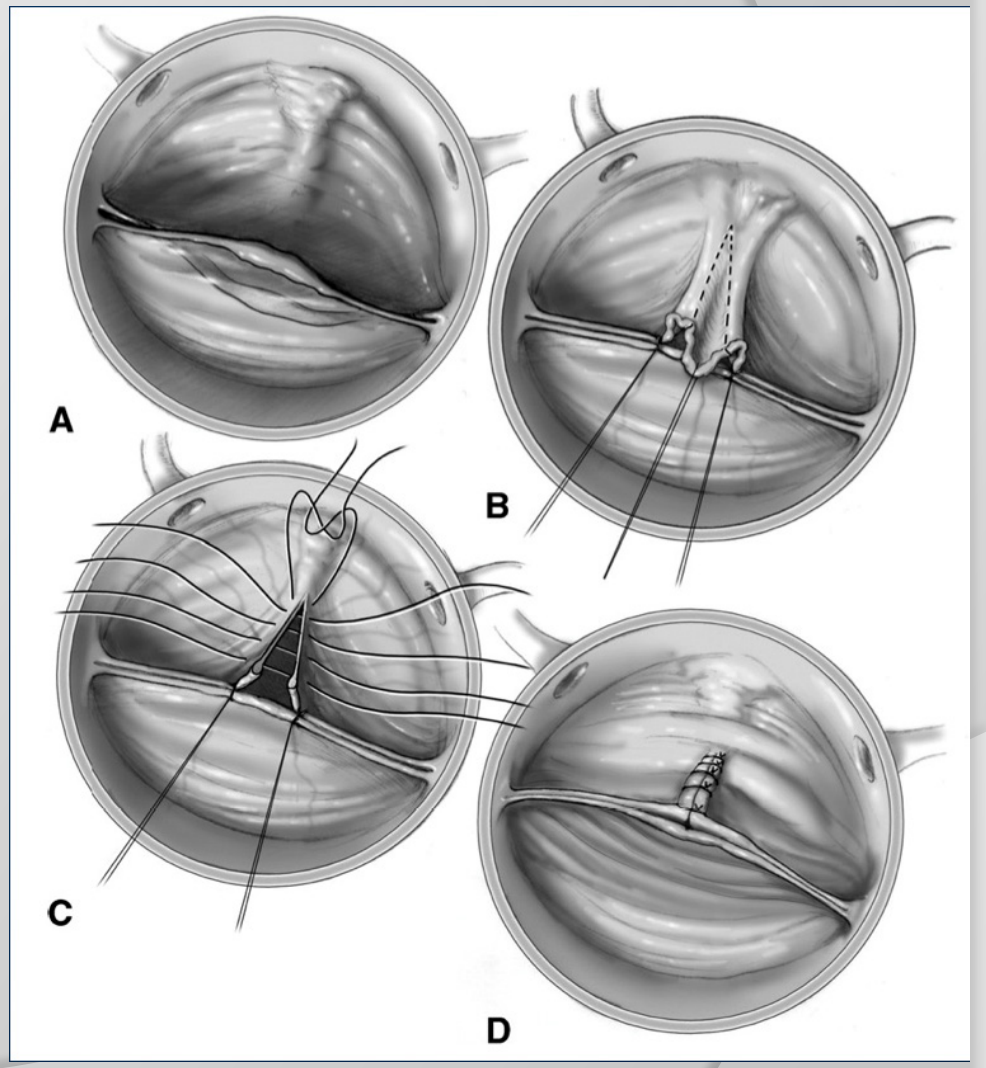
Commisural plication

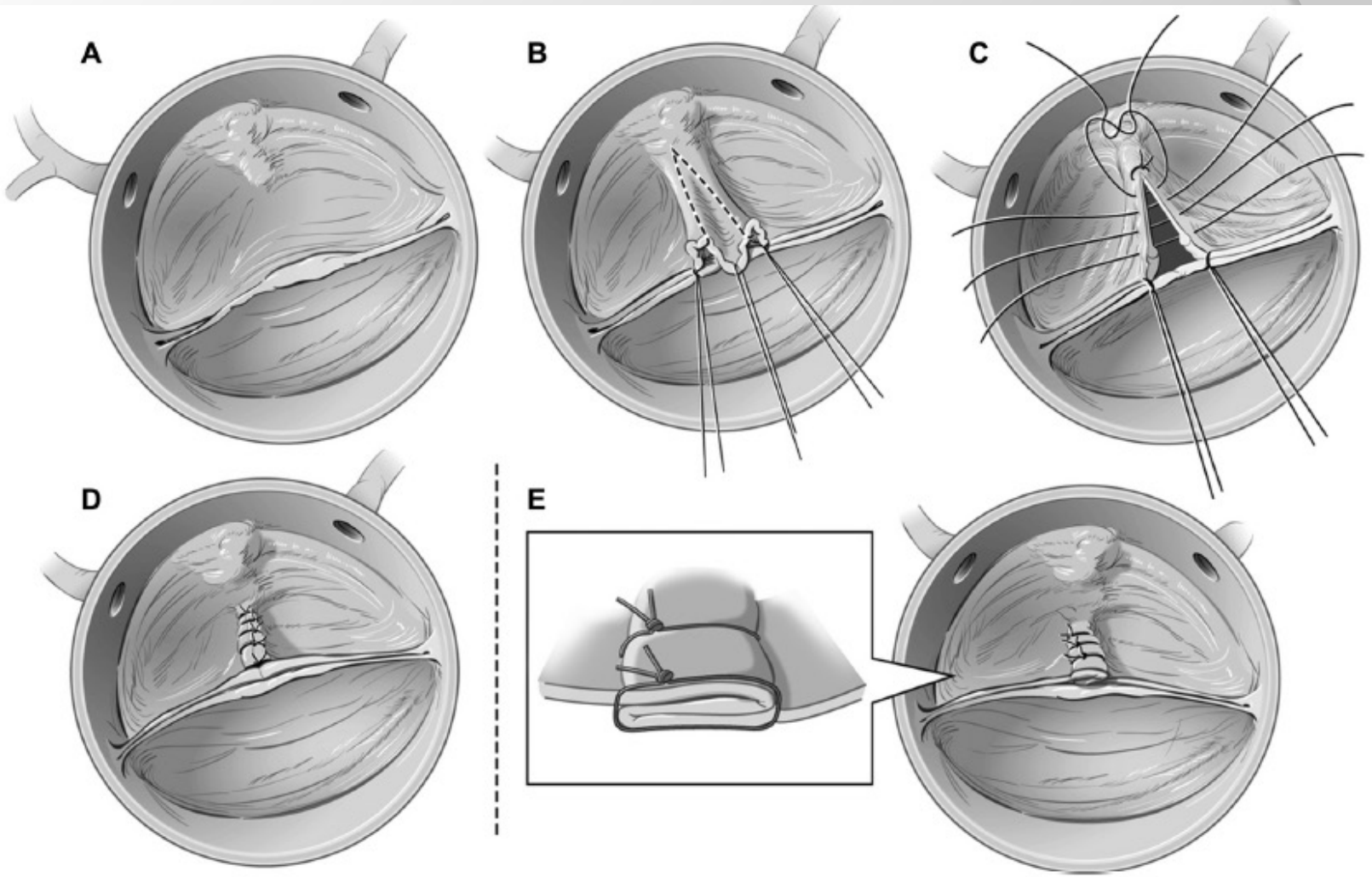
- Cabrol stitches to draw in excess
- Figure- of-8 stitches to increase height

Cusp Augmentation (pericardial patch)

Commisural Relocation

Triangular resection





Schematic 8. Conjoint cusp with excess tissue and prolapse (A), triangular resection when there is significant amount of excessive tissue (B) and interrupted suture closure of good quality margins (C, D). Plication preferred when cusp tissue is thin and less excessive (E).

doi:10.1510/mmcts.2009.004168

MULTIMEDIA MANUAL OF CARDIO THORACIC SURGERY MMCTS

Repair of bicuspid aortic valve with severe regurgitation

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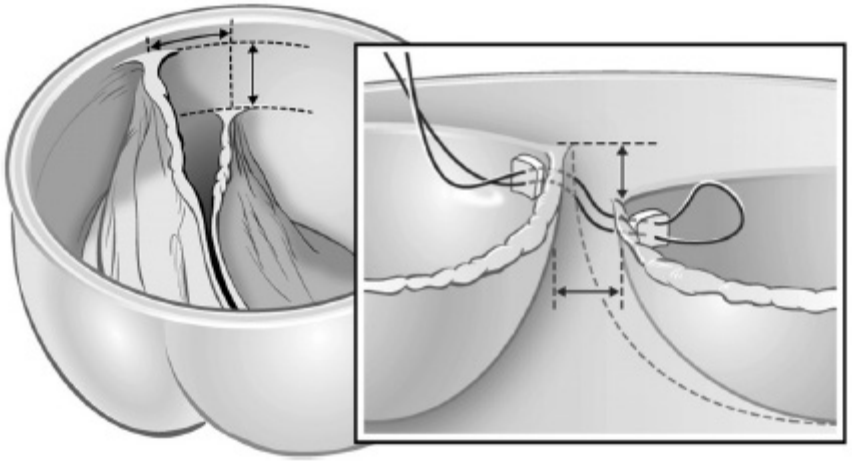
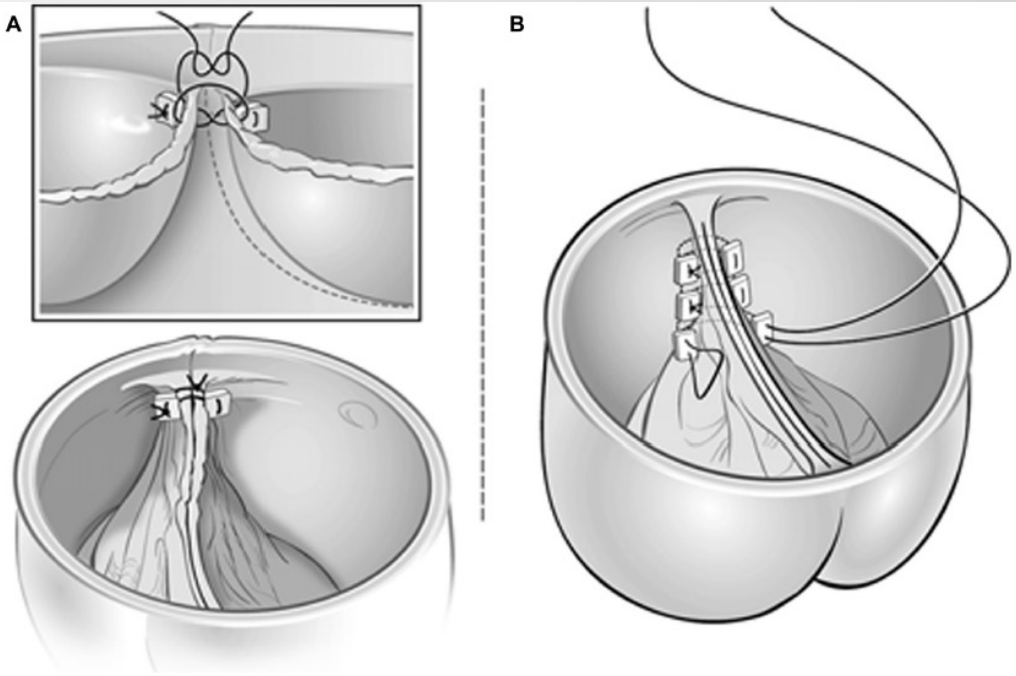


Schematic 12. Misalignment and splaying corrected with pledgeted oblique Cabrol-like stitch.



Schematic 13. A figure-of-8 stitch corrects minor splaying and is used alone or in combination with a Cabrol-like stitch (A). Deeper Cabrol stitches are also used for root and sinus manipulations (B).

Early results with annular support in reconstruction of the bicuspid aortic valve

Diana Aicher, MD, Ulrich Schneider, Wolfram Schmied, Dipl Psych, Takashi Kunihara, MD, Masato Tochii, MD, and Hans-Joachim Schäfers, MD, PhD

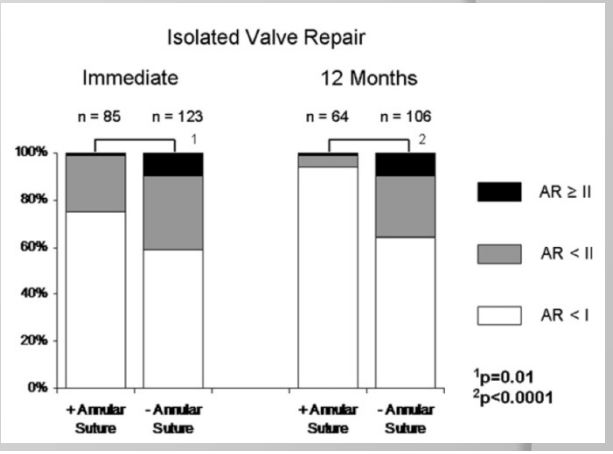
(J Thorac Cardiovasc Surg 2013;145:S30-4)

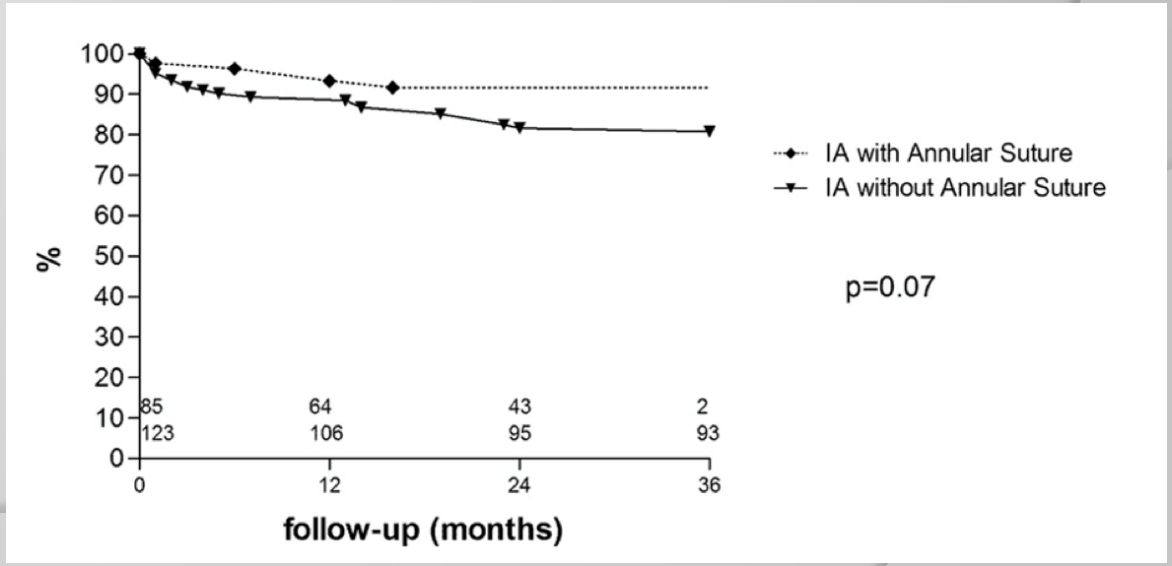
Plication

Triangular resection of cusps tissue

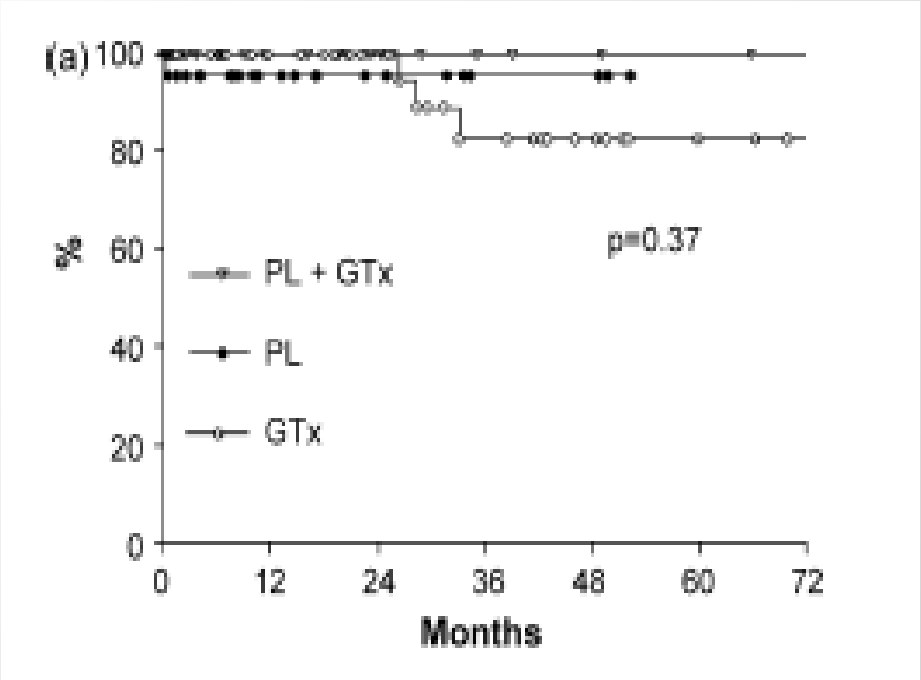
Pericardial patch for partial cusp replacement

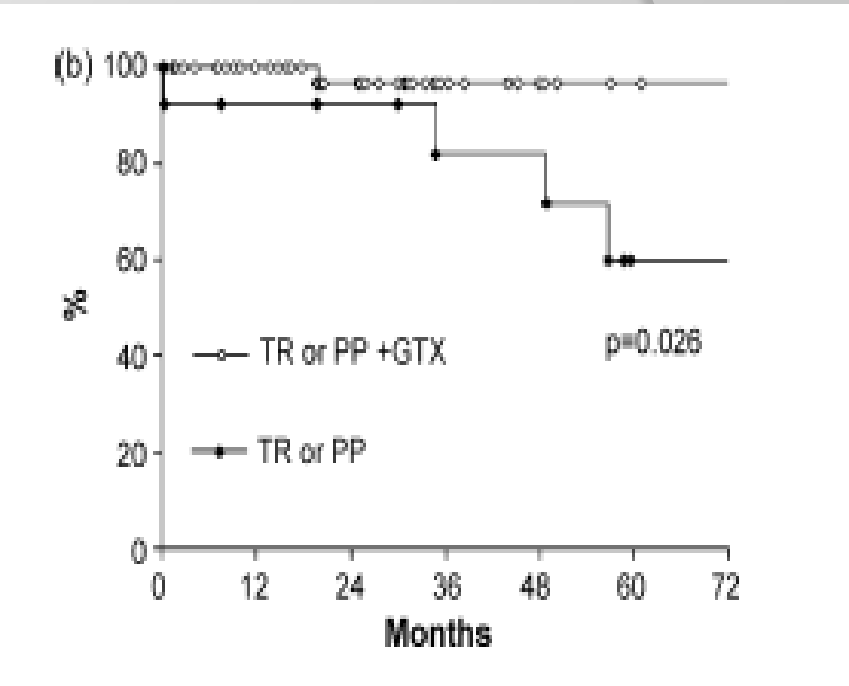
Annular Stabilization (ANNULOPLASTY)





Results: The Brussels Experience



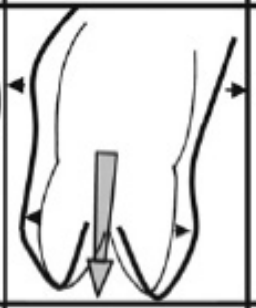
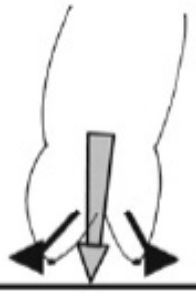


(a) Freedom from AR grade >2 in subgroups of patients having leaflet plication (PL), Gore-Tex resuspension (GTx) or the combination of PL + GTx and

(b) Freedom from AR grade >2 in subgroups of patients having triangular resection (TR) or pericardial patch repair (PP) alone or in combination with GTx

El Khoury et All Curr Opin Cardiol. 2005; 20(2):115-21.

Aortic Regurgitation Classification

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

Most Common combination BAV Ib/c + II usually associated with 15-25% larger annulus than standard for BSA

European Heart Journal (2014) 35, 2873–2926
doi:10.1093/eurheartj/ehu281

2014 ESC Guidelines on the diagnosis and treatment of aortic diseases

Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult

The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC)

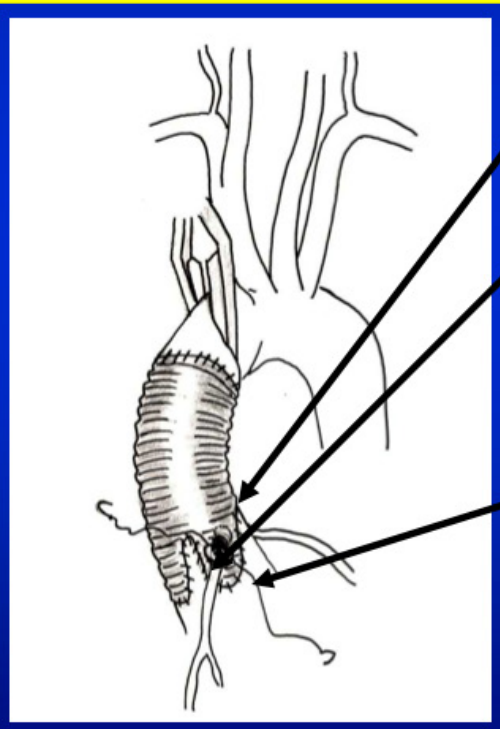
Recommendations on interventions on ascending aortic aneurysms

Recommendations	Class[a]	Level[b]
Surgery is indicated in patients who have aortic root aneurysm, with maximal aortic diameter[c] ≥50 mm for patients with Marfan syndrome.	I	C
Surgery should be considered in patients who have aortic root aneurysm, with maximal ascending aortic diameters: • ≥45 mm for patients with Marfan syndrome with risk factors.[d] • ≥50 mm for patients with bicuspid valve with risk factors.[e,f] • ≥55 mm for other patients with no elastopathy.[g,h]	IIa	C
Lower thresholds for intervention may be considered according to body surface area in patients of small stature or in the case of rapid progression, aortic valve regurgitation, planned pregnancy, and patient's preference.	IIb	C
Interventions on aortic arch aneurysms		
Surgery should be considered in patients who have isolated aortic arch aneurysm with maximal diameter ≥55 mm.	IIa	C
Aortic arch repair may be considered in patients with aortic arch aneurysm who already have an indication for surgery of an adjacent aneurysm located in the ascending or descending aorta.	IIb	C

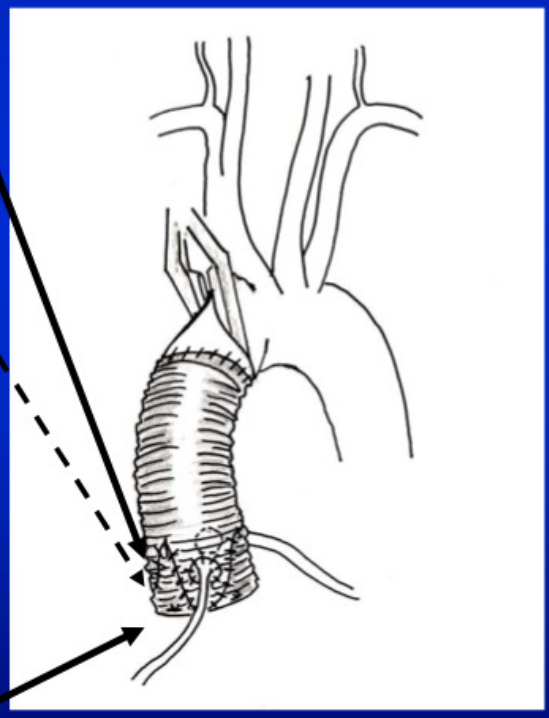
Valve sparing procedures

Remodeling of the aortic root
Yacoub 1983

Reimplantation of the aortic valve
David 1992



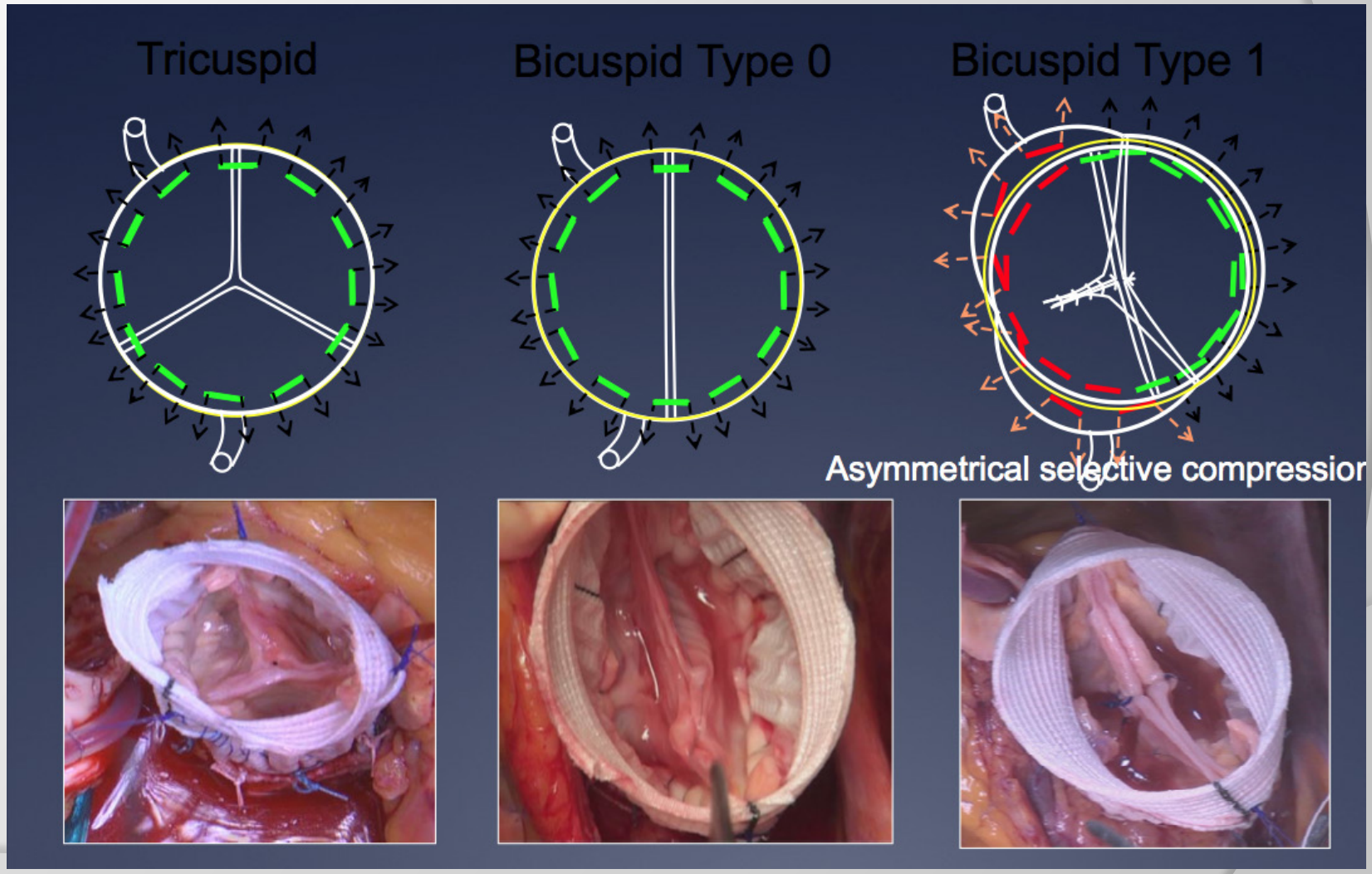
+	Treatment of STJ dilation	+
+	Sinuses of Valsalva	±
+	Aortic Root expansibility (interleaflet triangles)	-
-	Treatment of aortic annular base dilation	+



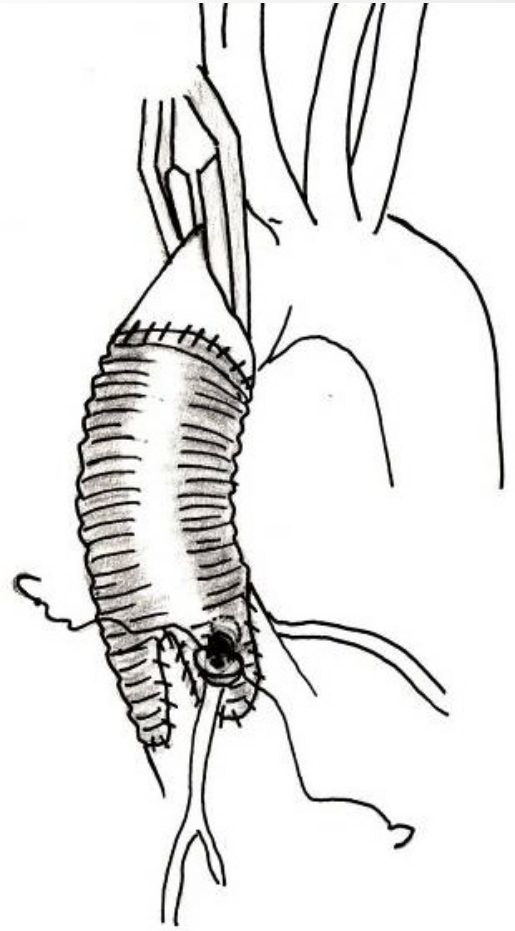
Supravalvular annuloplasty

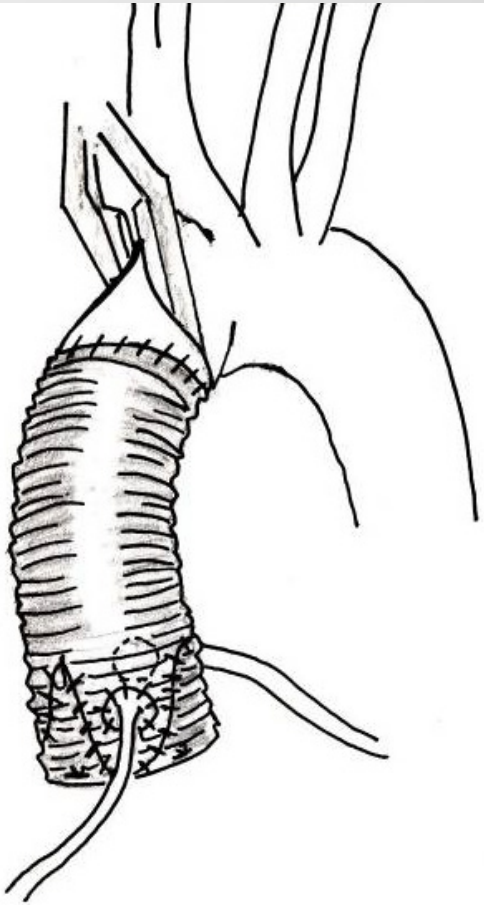
Sub and supravalvular annuloplasty

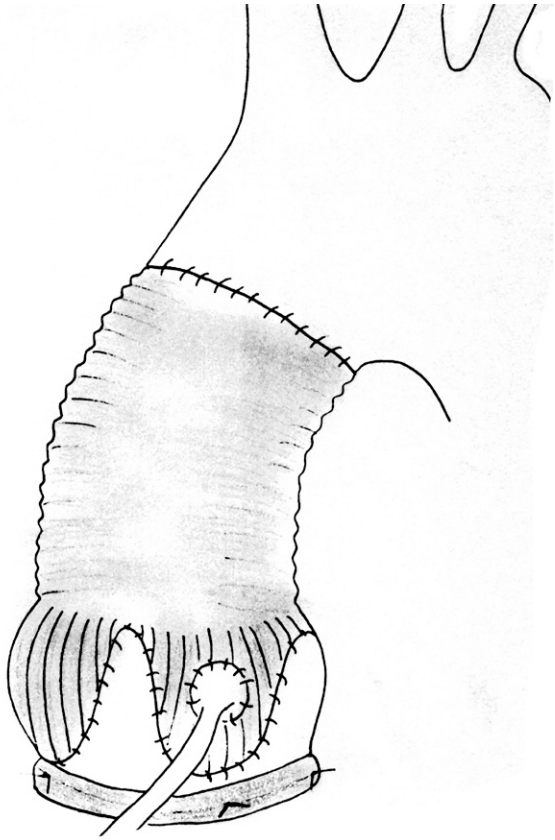
Impact of Reimplantation (proximal sutures) on VAJ Geometry



Physiological and standardized approach to Valve Sparing Root Replacement





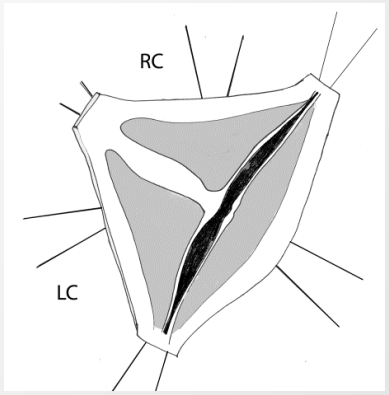


Remodeling 1983 Yacoub	Reimplantation 1992 David	Remodeling + subvalvular annuloplasty

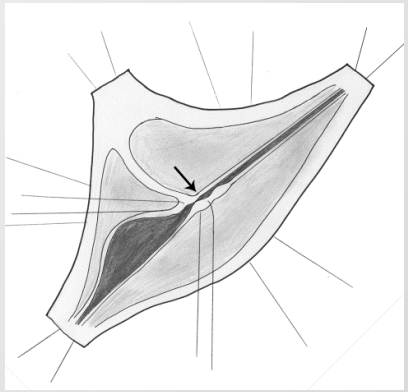
Curtesy of Prof Lansac

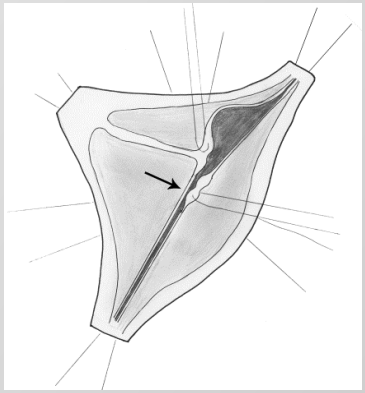
Root aneurysms: Bicuspid valves (Sinus Valsalva Ø ≥ 45 mm)

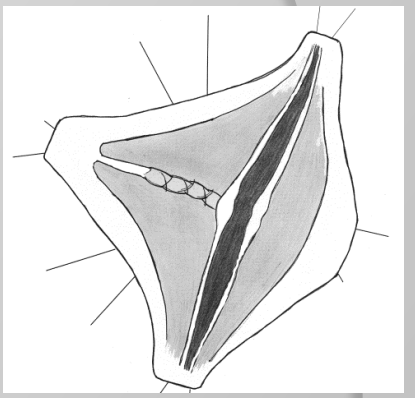
6 subvalvular « U » stitches



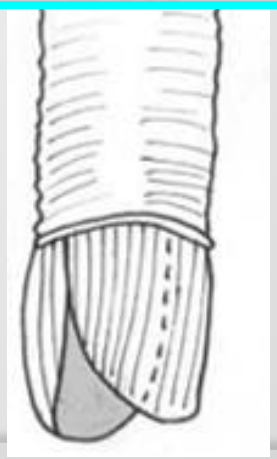
Aligment of cusp free edges



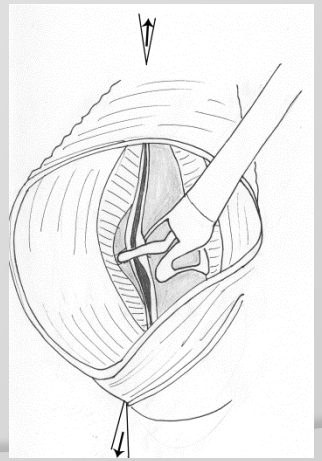




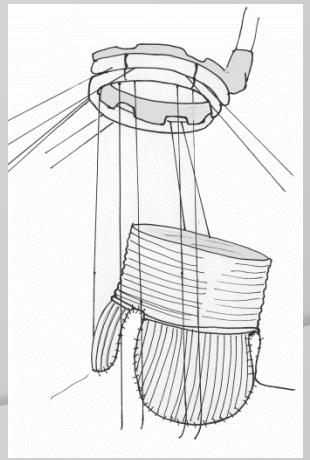
Commissures at 180°

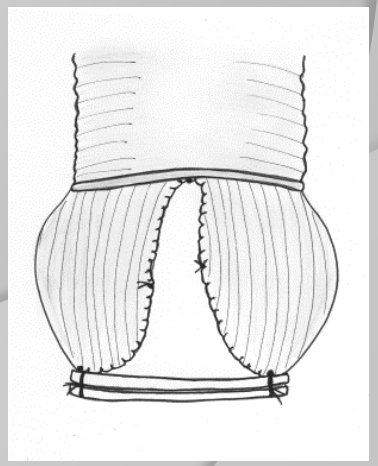


Effective height measurement



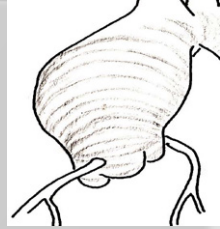
Subvalvular aortic annuloplasty



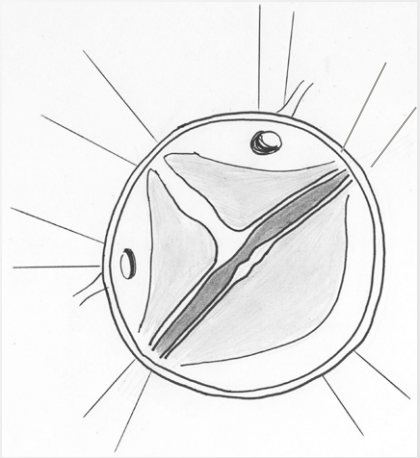


Curtesy of Prof Lansac

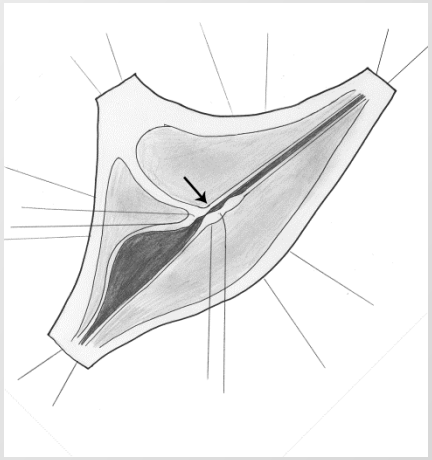
Root aneurysms: Bicuspid valves (Sinus Valsalva Ø 40- 45 mm)

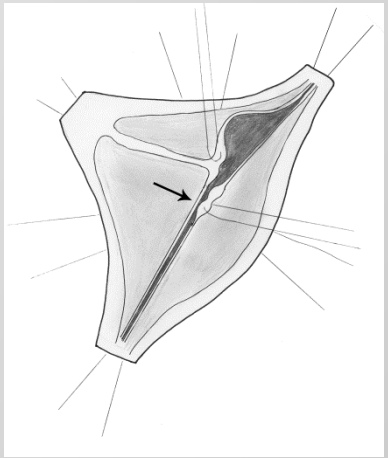


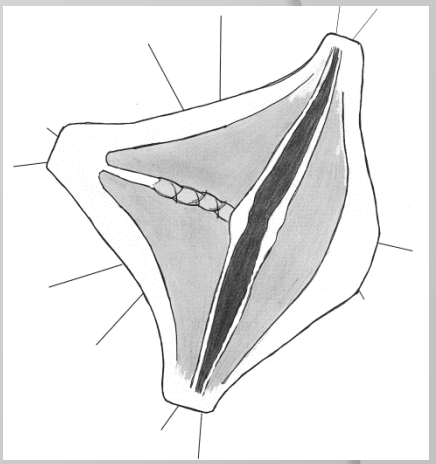
6 subvalvular « U » stitches



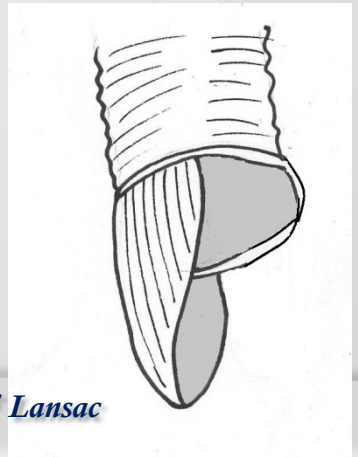
Aligment of cusp free edges



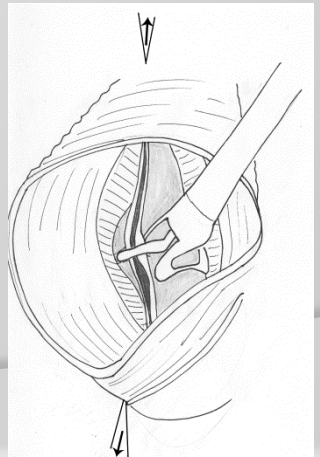




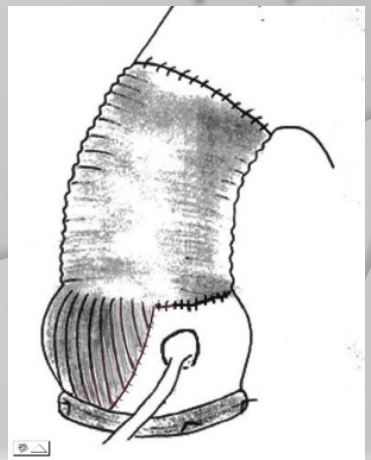
Commissures at 180°



Effective height measurement



Subvalvular aortic annuloplasty



Curtesy of Prof Lansac

Valve-preserving root replacement in bicuspid aortic valves

Hans-Joachim Schäfers, MD,[a] Takashi Kunihara, MD, PhD,[a] Peter Fries, MD,[b] Brigitte Brittner, MD,[a] and Diana Aicher, MD[a]

(J Thorac Cardiovasc Surg 2010;140:S36-40)

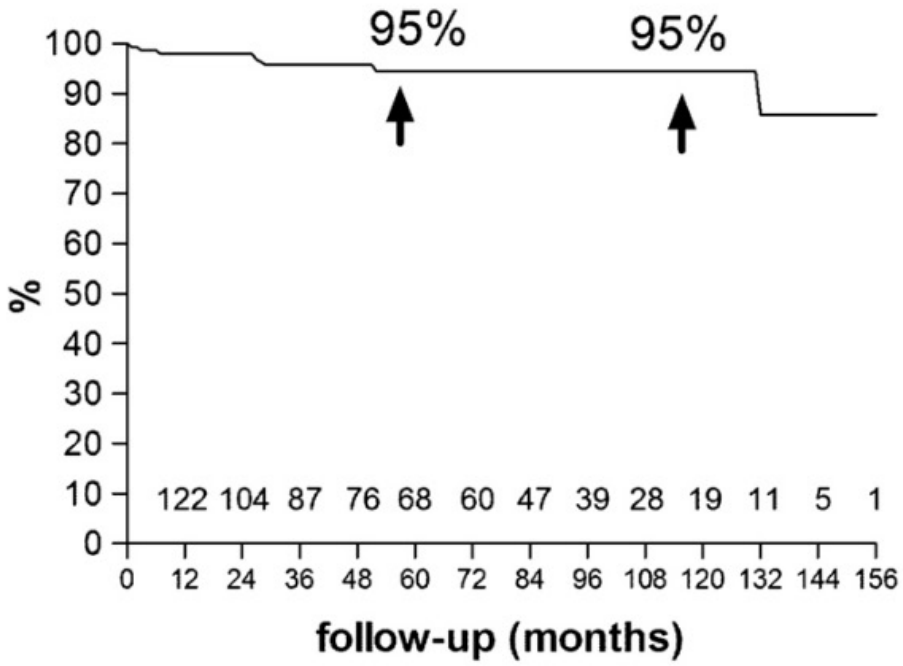


FIGURE 2. Actuarial freedom from reoperation after root remodeling in patients with BAV.

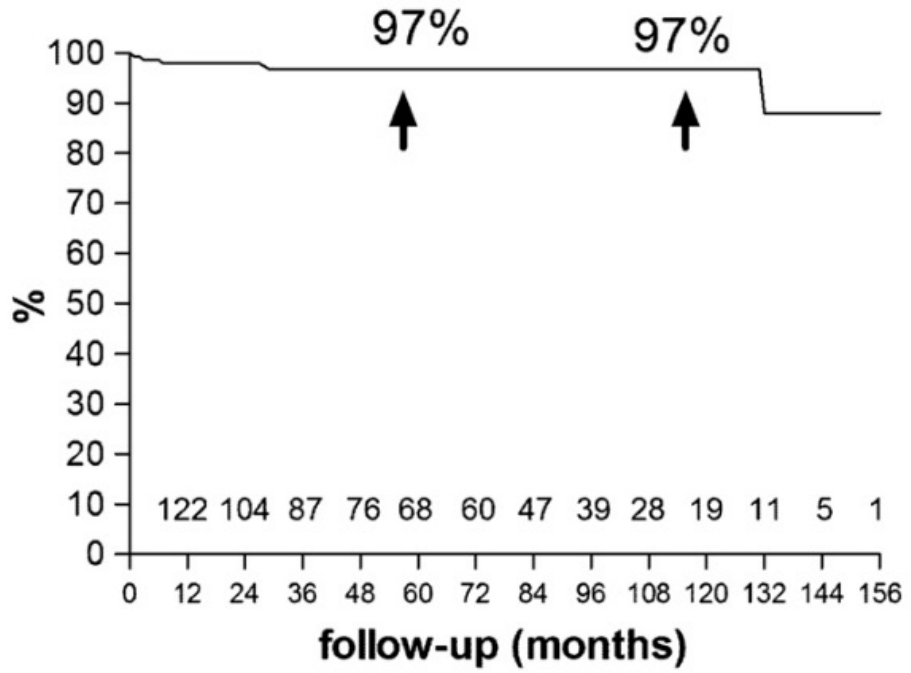


FIGURE 3. Actuarial freedom from valve replacement after root remodeling in patients with BAV.

(Ann Thorac Surg 2016;102:1221–8)

Bicuspid Aortic Insufficiency With Aortic Root Aneurysm: Root Reimplantation Versus Bentall Root Replacement

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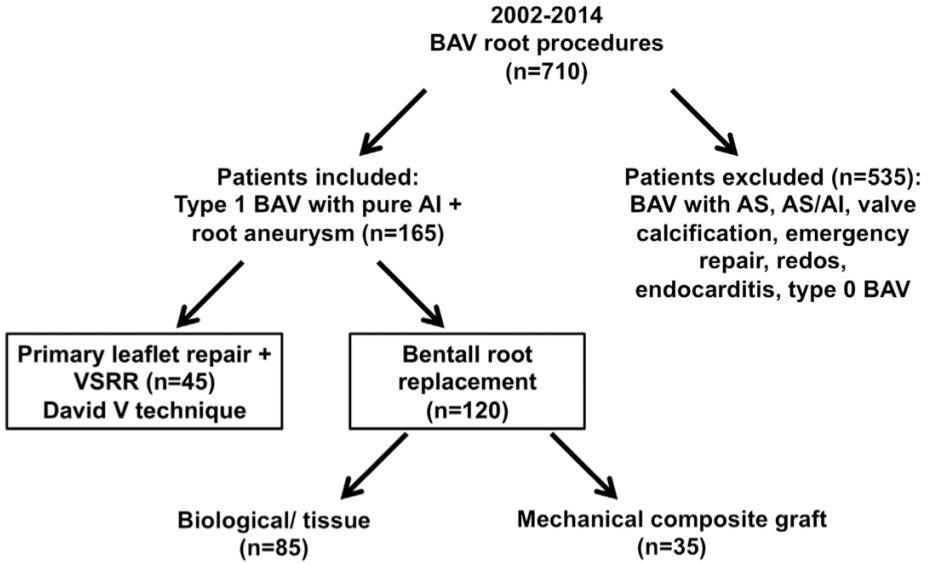

Table 1. Valve Repair Technique in the Valve-Sparing Root Reimplantation Group

Variable	VSRR (n = 45)
Primary leaflet repair	45 (100%)
Raphe release	29 (65%)
Resection with primary closure	5 (11%)
Gore-Tex free margin shortening	3 (7%)
Leaflet plication	34 (76%)
Leaflet decalcification	9 (20%)
Patch repair	0 (0%)
Fenestration repair	8 (17%)

VSRR = valve-sparing root reimplantation.

(Ann Thorac Surg 2016;102:1221–8)

Bicuspid Aortic Insufficiency With Aortic Root Aneurysm: Root Reimplantation Versus Bentall Root Replacement

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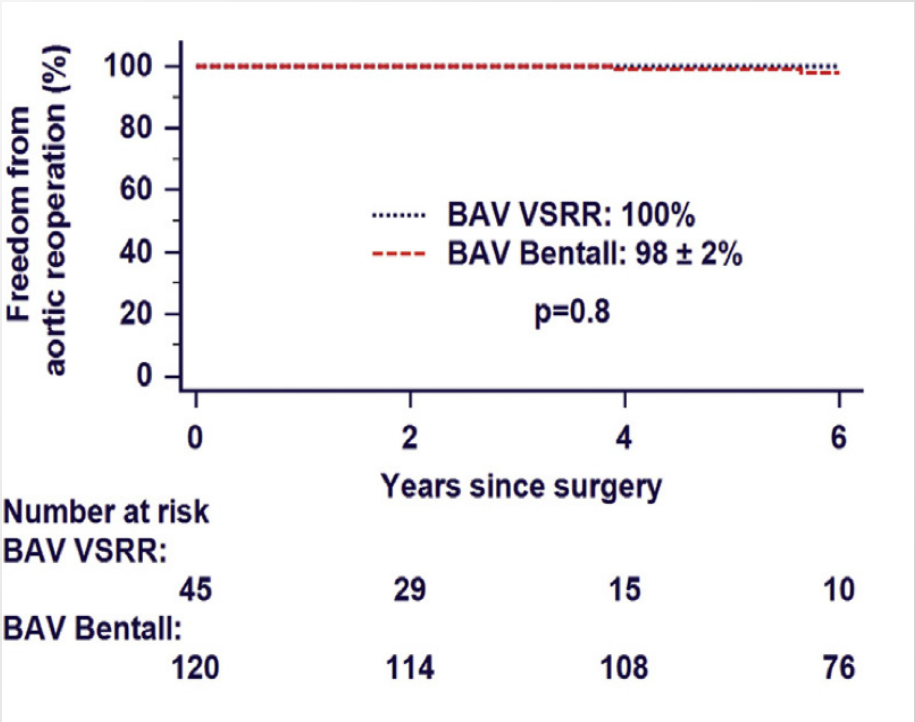

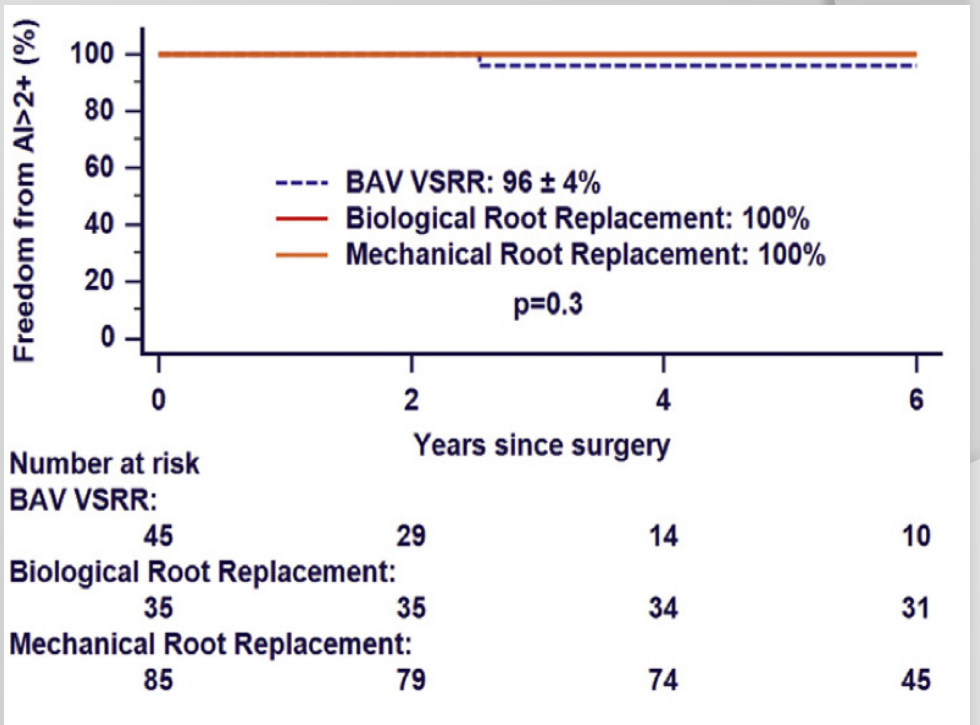

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REPORT

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Sutureless, rapid deployment valves and stented bioprosthesis in aortic valve replacement: recommendations of an International Expert Consensus Panel

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REPORT

Consider sutureless or rapid deployment as an alternative to stented valves in patients requiring aortic replacement with a biological valve, especially for redo or delicate aortic wall conditions as calcified root porcelain aorta or prior implantation of aortic homografts of stentless valves
Consider sutureless and rapid deployment as the valve prosthesis of first choice in cases requiring concomitant procedures and in case of small aortic annulus to reduce cross-clamp time
Preoperative CT scan recommended
Intraoperative transoesophageal echocardiography recommended
Suitable annular sizes (after decalcification) 19–27 mm
Oversizing with sutureless valves is not beneficial and can have negative impact
Contraindication for bicuspid valve type 0
Implantation possible in bicuspid valves type 1 and 2 if
coronary ostia do not have 180° position,
annulus round
uniform height of the commissures (Type 2)
Contraindication for annular abscess or destruction due to infective endocarditis
Careful but complete decalcification of the aortic root is recommended to avoid paravalvular leakage; extensive decalcification should be avoided not to create annular defects

Table 3: Consens… …stheses after second and third ro… …ders number is not 29) of the par…

Consensus recommend…									Number of responders
Proctoring and educati… well as for the indivi…									29
Consider sutureless or … replacement with a b… porcelain aorta or pr…									29
Consider sutureless and… concomitant proced…									29
Preoperative CT scan re…									29
Intraoperative transoes…									29
Suitable annular sizes (a…									29
Oversizing with suturel…									27
Contraindication for bi…									28
Implantation possible i…									24
coronary ostia do no…									29
annulus round									29
uniform height of the…									29
Contraindication for an…									29
Careful but complete decalcification of the aortic root is recommended to avoid paravalvular leakage; extensive decalcification should be avoided not to create annular defects	C	I	79	17	3	0	0		29
Recommendation of proximal anastomoses of concomitant CABG during single aortic cross-clamp period	C	I	52	17	31	0	0		29

CT: computer tomography; CABG: coronary artery bypass grafting;

Sutureless aortic valve replacement in patients who have bicuspid aortic valve

Anthony Nguyen, MD, MSc,[a,b] Wil
Michel Carrier, MD, MBA,[a,b] Isma
Philippe Demers, MD[a,b]

EDITORIAL COMMENTARY

Dealing with a stenotic bicuspid aortic valve: Is this still an off-label procedure for a sutureless valve?

Mattia Glauber, MD, Matteo Ferrarini, MD, Antonio Lio, MD, and Antonio Miceli, MD, PhD

2 key points for a perfect sealing of the Perceval BAV:

- ✓ *the circularity of the aortic annulus*
- ✓ *the equality of heights of the leaflet commissures.*

Anatomic asymmetry of the BAV → recreate 3 natural nadir points positioned at 120 degrees with the aim of recreating a circular annulus (only for Type I BAV with 3 sinuses)

To prevent PVL a commissural plication is often required to restore the circularity of the aortic annulus, especially when the commissures are placed at different heights

Decalcification of the aortic annulus is recommended to restore its elasticity and adaptability to the newly implanted prosthetic valve

TAVI in Bicuspid Aortic Stenosis

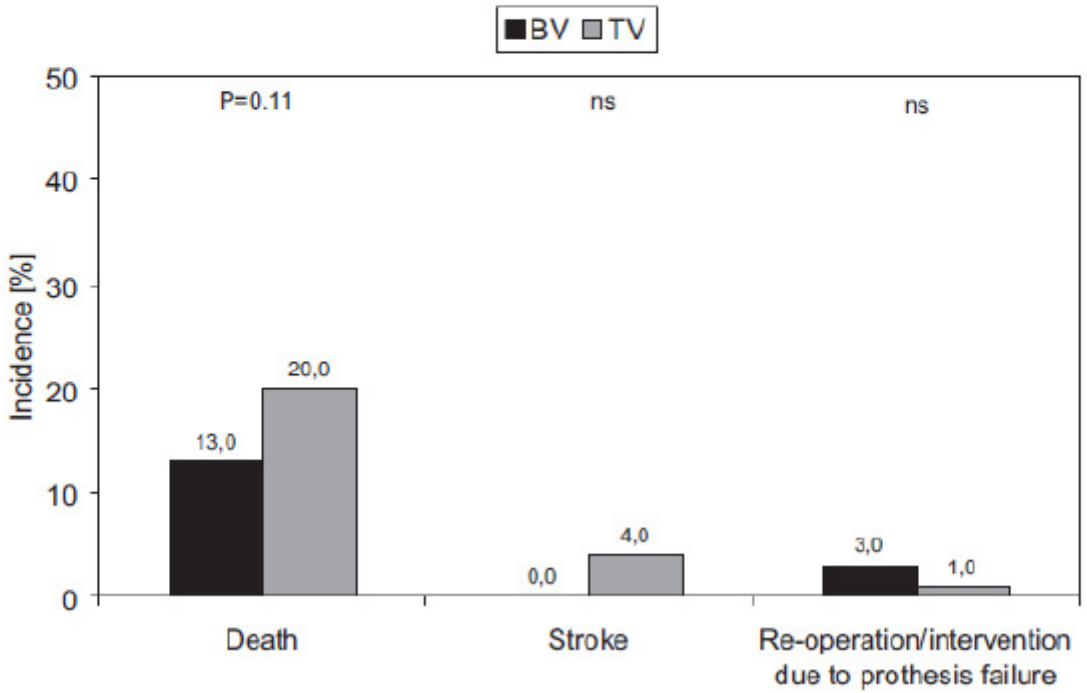
- Relative contraindication to TAVI

- Specific concerns:
  1. An elliptically shaped annulus that may impair valve positioning and sealing
  2. Asymmetrical and heavy calcification of leaflets may impede valve expansion and valve hemodynamics (e.g., higher transvalvular gradients and paravalvular leak)
  3. Presence of aortic disease increases the risk of dissection or rupture during valvuloplasty, postdilatation, or implantation of balloon-expandable valves
  4. Fused commissures are susceptible to disruption during balloon valvuloplasty, resulting in severe aortic regurgitation
  5. Underexpansion and/or a non-circular shape of the transcatheter heart valve may affect long-term durability

Colombo A, Latib A. J Am Coll Cardiol. 2014 Dec 9;64(22):2340-2

TAVI in Bicuspid Aortic Stenosis: 1-Year Outcome

German TAVI Registry:
BAV (n=38, 3%) vs. TAV (1'357, 97%)



Bauer T et al. Am J Cardiol. 2014 Feb 1;113(3):518-21

TAVI in Bicuspid Aortic Stenosis: Aortic Regurgitation

Aortic regurgitation Grade≥2:
28.4% → 17% (sizing with MSCT)

	Univariate Analysis			Multivariate Analysis		
Characteristic	Odds Ratio	95% CI	p Value	Odds Ratio	95% CI	p Value
Age	0.95	0.96-1.03	0.63			
Males	3.50	1.50-8.20	0.004	4.29	1.63-10.79	0.003
STS PROM	0.85	0.75-1.04	0.05	0.88	0.75-1.04	0.13
Mean aortic gradient	0.99	0.97-1.02	0.61			
Aortic valve area	3.20	0.34-29.86	0.31			
LV ejection fraction <40%	1.40	0.62-3.14	0.41			
Annulus size	0.93	0.82-1.04	0.20			
TAV size	1.10	0.92-1.31	0.31			
MSCT-based TAV sizing	0.23	0.10-0.51	<0.0001	0.19	0.08-0.45	<0.0001
Bicuspid type 1	2.14	0.82-5.56	0.11			
CoreValve	1.93	0.82-4.54	0.13			
Year of procedure	0.78	0.60-1.03	0.08			

Mylotte D et al. J Am Coll Cardiol. 2014 Dec 9;64(22):2330-9

Essentials of Leaflet Repair

Simmetry in coaptation and height