# Aortic Valve Repair – Introduction

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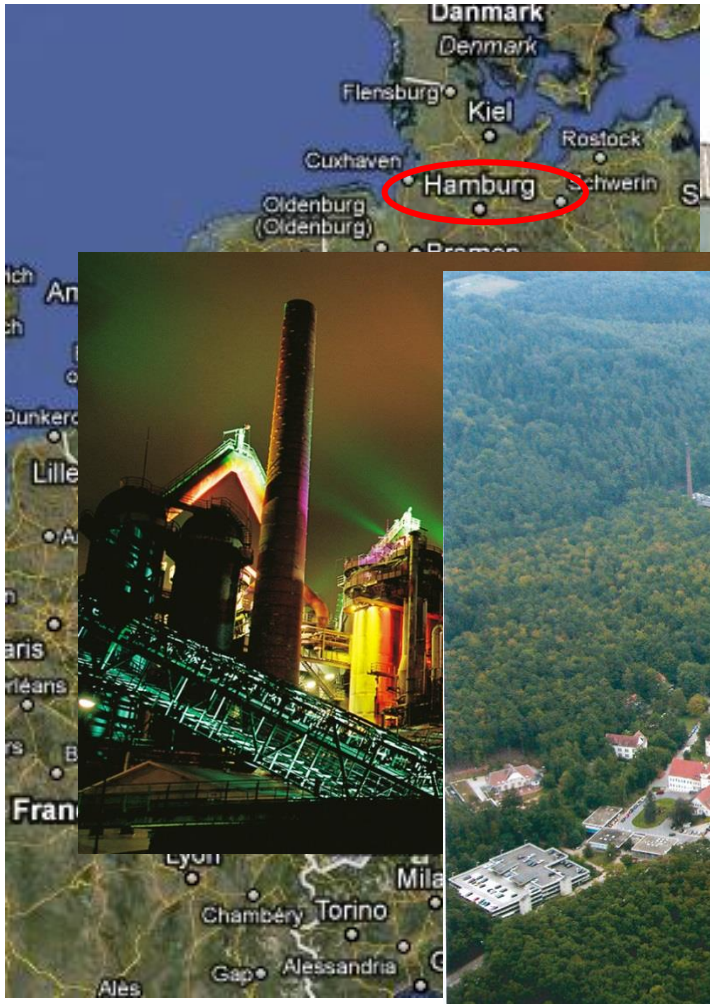
**Leonardo da Vinci:**

**Trattato della Pittura (da Vinci)/Parte seconda/77. Dell'errore di quelli che usano la pratica senza la scienza**

«Sempre la pratica dev’essere edificata sopra la buona teorica, della quale la prospettiva è guida e porta, e senza questa nulla si fa bene.»

**“Practice should always be based upon a sound knowledge of theory. Without this guidance and door nothing will be done well”**


Danmark
Denmark
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Cuxhaven
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Lille
Chambéry
Torino
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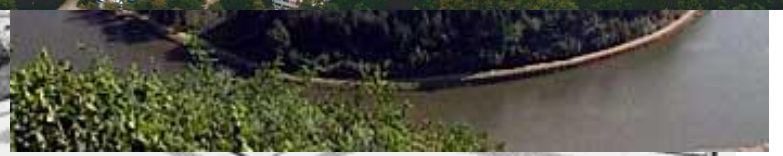
Ales



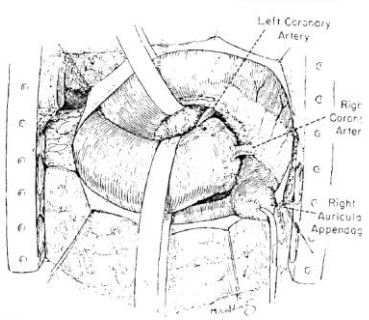


# Aortic Valve - Historic Repair Attempts

THE SURGICAL CORRECTION OF AORTIC INSUFFICIENCY BY CIRCUMCLUSION

WARREN J. TAYLOR, M.D. (BY INVITATION), WENDELL B. THROWER, M.D. (BY INVITATION), HARRISON BLACK, M.D., AND DWIGHT E. HARKEN, M.D.
BOSTON, MASS.

J. Thoracic Surg.
February, 1958




—Details of coronary artery dissection. Division of conus ligament after left coronary artery.

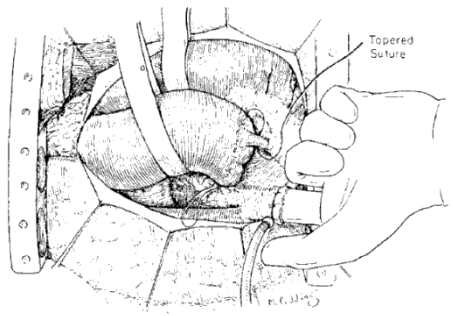



Fig. 6.—Double-tapered suture ligature passed under coronary arteries, anchored low in relation to neutral (noncoronary) cusp. Finger as guide is in right atrium.

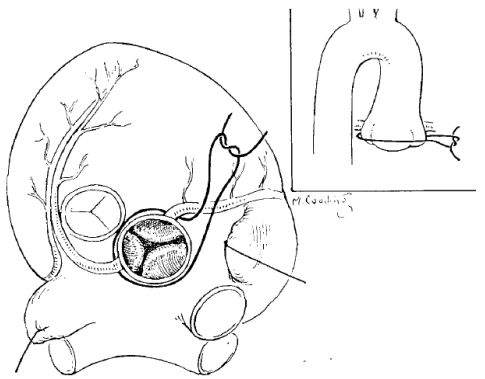


Fig. 7.—Location of circumcluding ligature.

# Aortic Valve Replacement

Reproducible

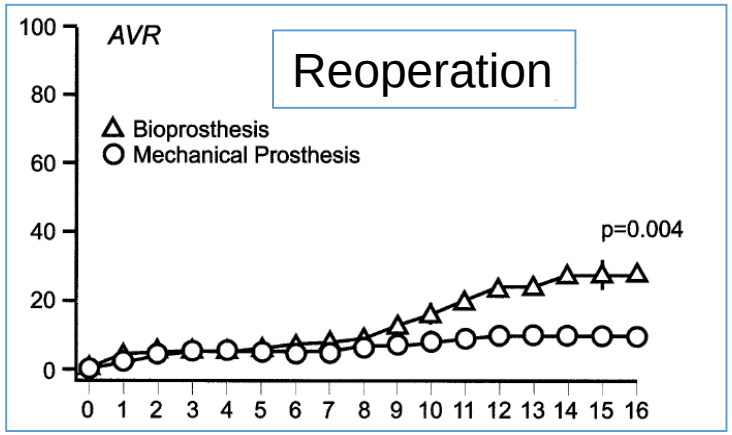
Low Mortality
(curr. 2-4%)

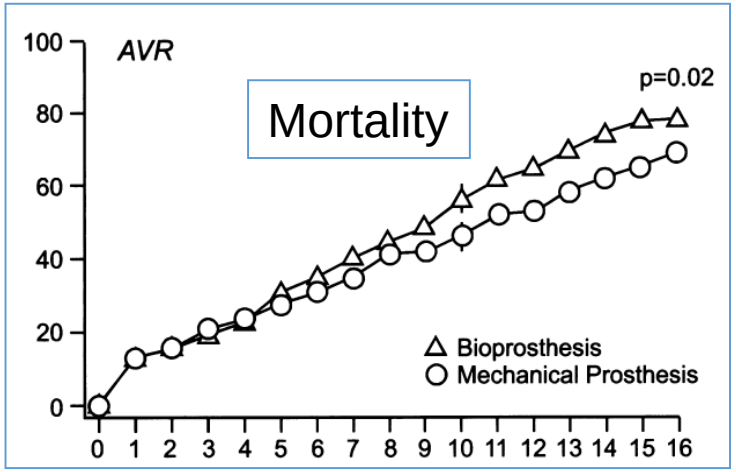
Late complications:

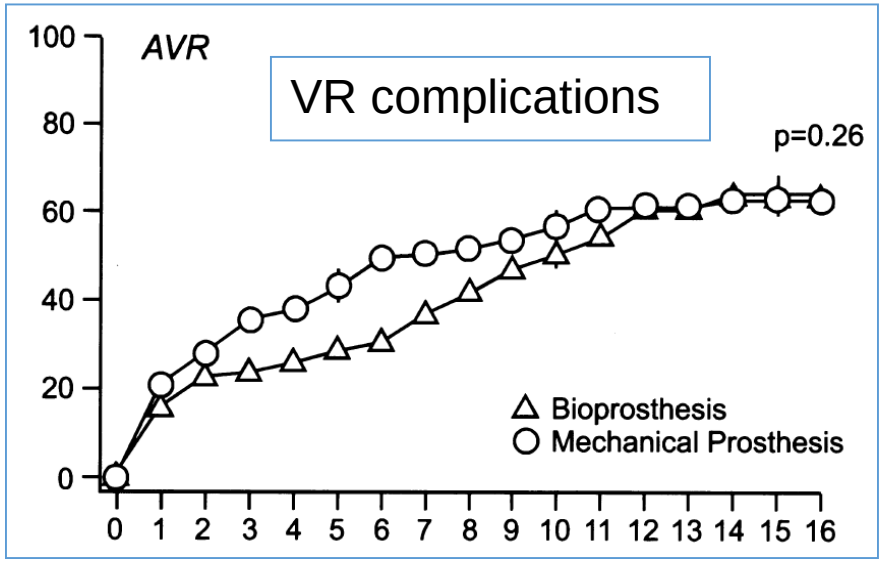
Thromboembolism
Anticoagulation/Hemorrhage
Structural failure
PV endocarditis

# Outcomes 15 Years After Valve Replacement With a Mechanical Versus a Bioprosthetic Valve: Final Report of the Veterans Affairs Randomized Trial

Karl Hammermeister, MD, FACC,* Gulshan K. Sethi, MD, FACC,† William G. Henderson, PHD,‡
Frederick L. Grover, MD, FACC,* Charles Oprian, PHD,‡
Shahbudin H. Rahimtoola, MB, FRCP, MACP, MACC§



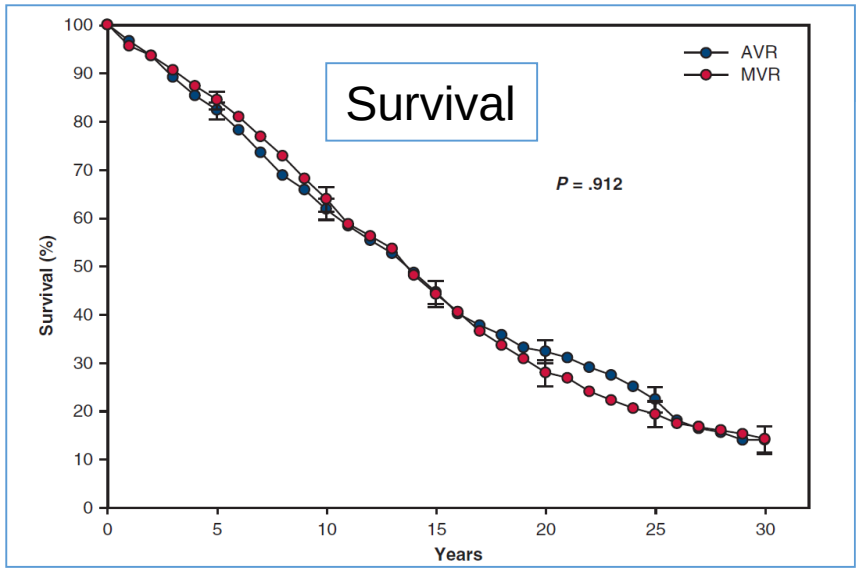




(J Am Coll Cardiol 2000;36:1152–8)

# Thirty-year experience with a bileaflet mechanical valve prosthesis

Scott Johnson, MD,[a] Martha R. Stroud, MS,[a] John M. Kratz, MD,[a] Scott M. Bradley, MD,[a] Fred A. Crawford, Jr, MD,[a] and John S. Ikonomidis, MD, PhD[b]

| | |
|---|---|
| Operative mortality | 17 (3%) |



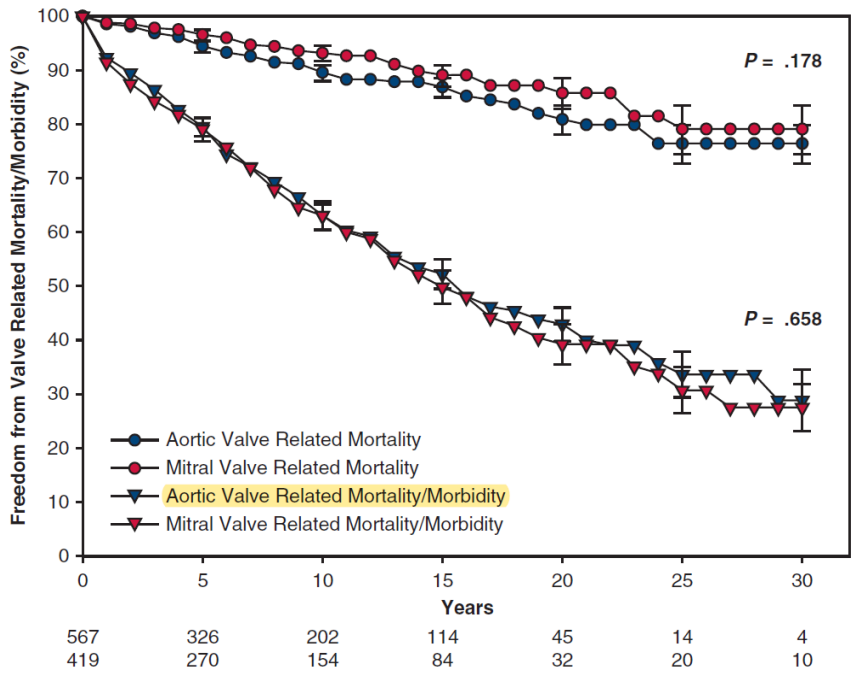
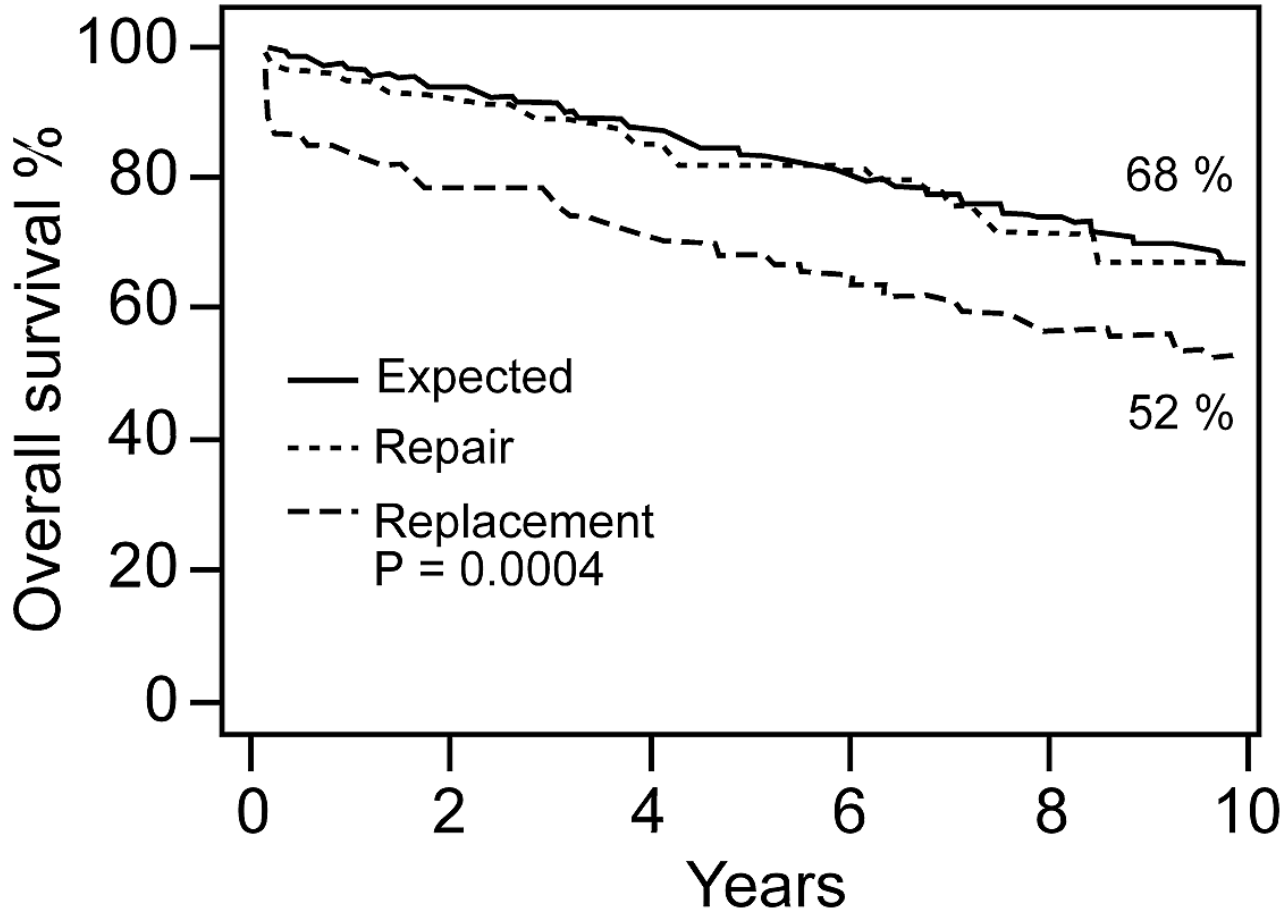



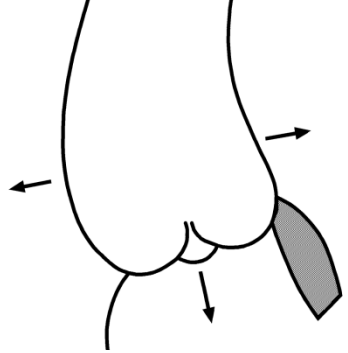

**FIGURE 7.** Actuarial and "actual" freedom from valve-related morbidity or mortality after AVR and MVR.

# Repair vs. Replacement (Mitral)

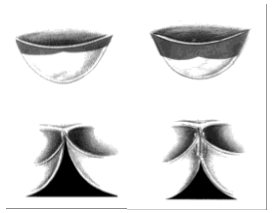


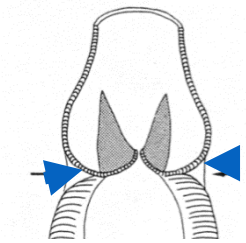

Mohty D, Curr. Card. 2002

# Root Repair – Technical Options



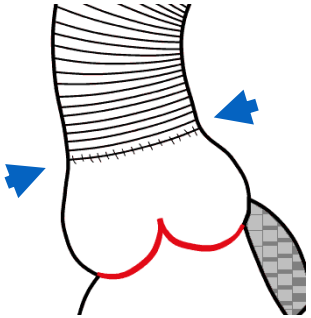
Subcommissural Plication





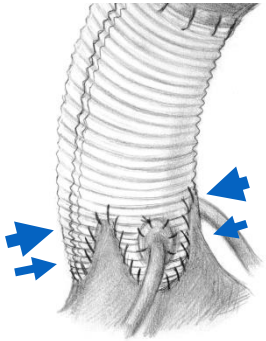
(Cabrol 1966)

ST Junction Remodelling



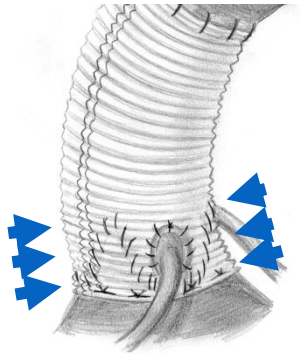
(Frater 1986)
(Sinus < 45 mm)

Root Remodeling



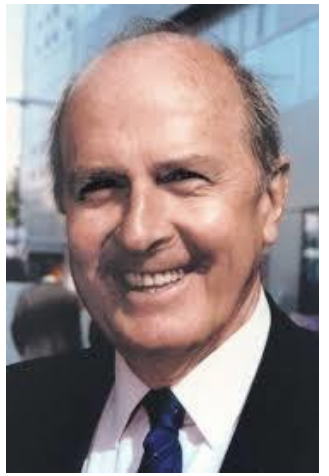
(Yacoub 1993)

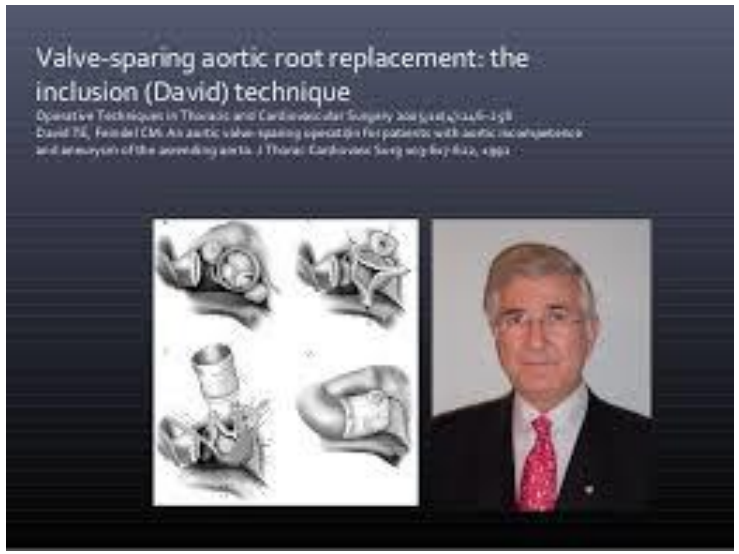
Reimplantation of Aortic Valve



(David 1992)

# 1992




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

# Aortic Valve Repair

## Valve-Sparing Operation in Aortic Root Ectasia

Hans-Joachim Schäfers and Hans G. Borst

Aortic valve regurgitation caused by aortic root ectasia is a common finding.[1,2] The most common cause for this pathological complex is a diffuse degenerative process of connective tissue involving the media of the aortic wall, such as in Marfan's syndrome. Fragmentation and dissarray of elastic fibers, formally described as cystic media necrosis, leads to hyperelasticity and decreased mechanical stress resistance. In addition to Marfan's syndrome, root ectasia has also been observed in other patients with or without apparent association to connective tissue disease.[3]

The risk of dissection or rupture of the ascending aorta and left ventricular volume overload caused by aortic regurgitation define the need for surgical intervention in patients with advanced stages of the disease. Insertion of a valved conduit is still regarded the gold standard for treatment of root ectasia.[4,5] However, despite favorable perioperative results, the typical long-term risks of alloprosthetic valve replacement

ated fibrous parts of the aortic root are preserved and resuspended within a vascular graft. Compared with mechanical prostheses, the long-term risks and disadvantages of anticoagulation are avoided. Originally, this operation was proposed for elective correction of root ectasia. We have also used it in root ectasia in conjunction with acute or chronic type I aortic dissection.

### Indications for Surgery

In most patients, the decision for surgical intervention is made on the basis of the diameters of the aortic root and/or ascending aorta. A diameter of more than 5 cm has been shown to be associated with an increased risk of perforation or dissection and has been the standard cut-off point for decision making in replacement of the ascending aorta. Clinical observations indicate that, in patients with connective tissue disease (eg, Marfan syndrome) or familial history of aortic dissection, an

Operative Techniques in
Cardiac & Thoracic Surgery
A Comparative Atlas

Editors - James L. Cox, MD  Thoralf M. Sundt III, MD

Vol 1, No 1  July 1996

**Aortic Valve Repair**

# Aortic Valve Repair

## VALVE-PRESERVING REPLACEMENT OF THE ASCENDING AORTA: REMODELING VERSUS REIMPLANTATION

H.-J. Schäfers, MD, PhD[a]
R. Fries, MD[b]
F. Langer, MD[a]
N. Nikoloudakis, MD[a]
T. Graeter, MD[a]
U. Grundmann, MD[c]

***Objective:*** **Aortic valve regurgitation in combination with dilatation of the ascending aorta and root requires a combined procedure to restore valve function and eliminate pathologic dilatation of the proximal aorta. Two techniques have been proposed for this purpose; the aortic root may be either remodeled with an especially configured vascular graft or replaced with reimplantation of the aortic valve within the graft. We have used both techniques depending on the individual pathologic condition of the aortic root.** ***Methods:*** **Of 107 patients undergoing operation**

**(J Thorac Cardiovasc Surg 1998;116:990-6)**

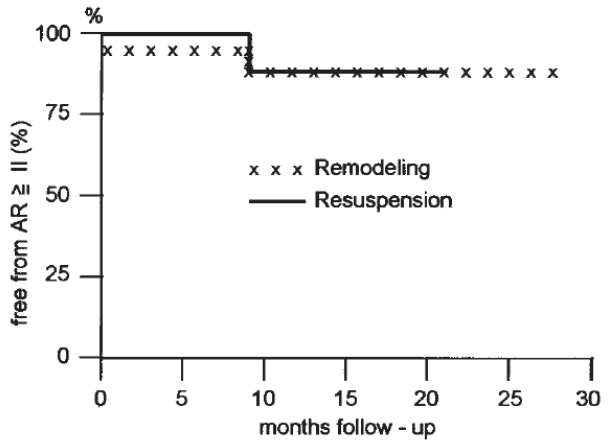
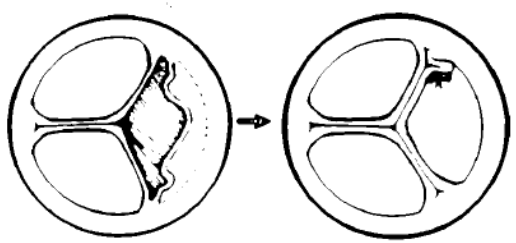


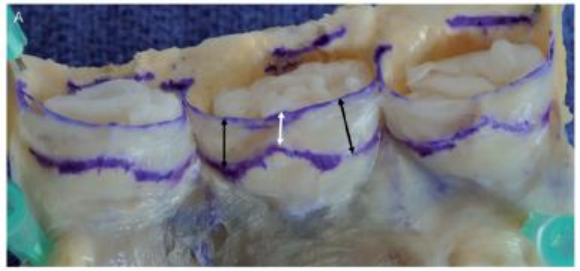

**Fig 4.** Actuarial freedom from postoperative aortic regurgitation grade II or higher in reimplantation and remodeling techniques.

- ✓ All cusp margins should be at equal height for competent valve function.

- ✓ Coaptation height should be high for secure diastolic function.



- ✓ Cusp configuration should be maintained under systemic pressure.



Duran CMG, J Card S
De Kerchove L, Eur J Car
2018

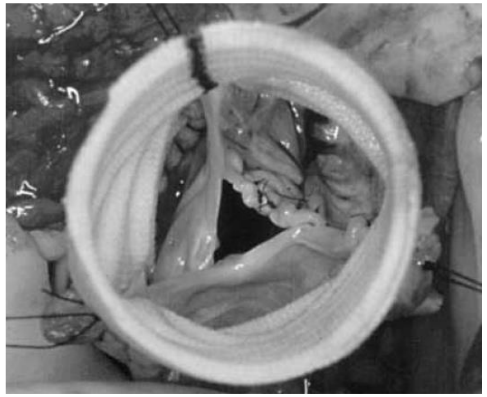
# Aortic Valve Repair

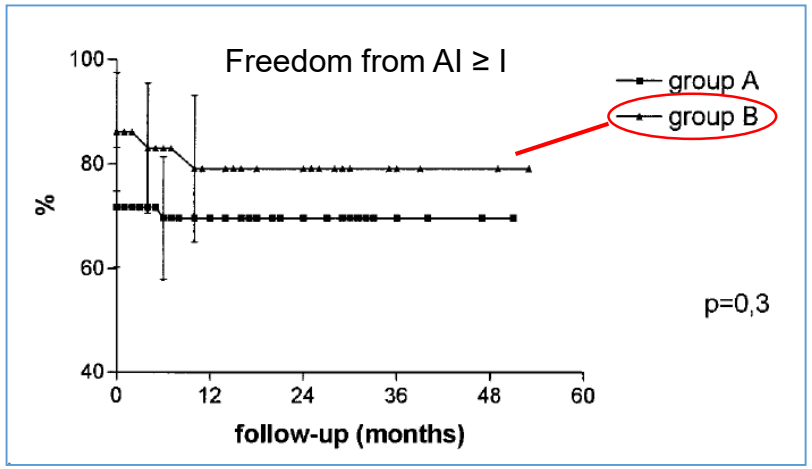
**Valve-preserving aortic replacement: Does the additional repair of leaflet prolapse adversely affect the results?**

Frank Langer, MD
Thomas Graeter, MD
Nikolaous Nikoloudakis, MD
Diana Aicher, MD
Olaf Wendler, MD
Hans-Joachim Schäfers, MD, PhD

**Objective:** Valve-preserving aortic replacement has evolved into an accepted therapeutic option for aortic ectasia with morphologically intact leaflets. Some patients, however, exhibit additional leaflet prolapse. We compared the results of established valve-preserving techniques with those of the combination of valve-preserving aortic surgery and additional repair of leaflet prolapse.

The Journal of Thoracic and Cardiovascular Surgery • August 2001





# In vitro comparison of aortic valve movement after valve-preserving aortic replacement

Roland Fries, MD,[a] Thomas Graeter, MD,[b] Diana Aicher, MD,[b] Helmut Reul, MD,[c] Christoph Schmitz,[c] Michael Böhm, MD,[a] and Hans-Joachim Schäfers, MD[b]

**Objective:** In aortic valve regurgitation and aortic dilatation, preservation of the aortic valve is possible by means of root remodeling (Yacoub procedure) or valve reimplantation (David procedure). In vivo studies suggest that reimplantation might substantially influence aortic valve-motion characteristics. Evaluation of aortic valve movement in vivo, however, is technically limited and is difficult to standardize. We evaluated the aortic valve-motion pattern echocardiographically in vitro after reimplantation and remodeling.

The Journal of Thoracic and Cardiovascular Surgery • July 2006

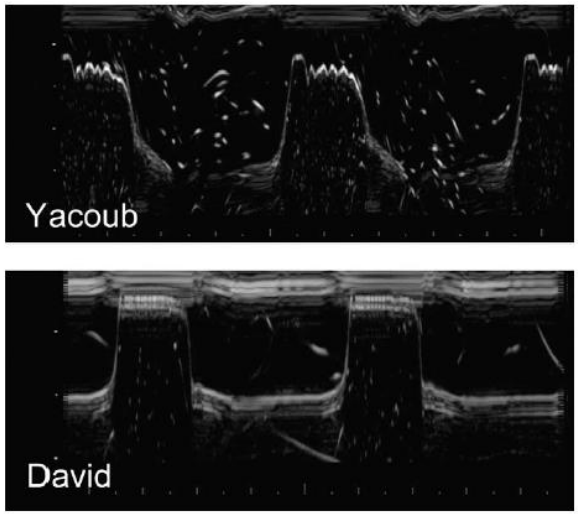



Figure 3. Typical M-mode recording of aortic valve motion after reimplantation *(David)* and remodeling *(Yacoub)*.

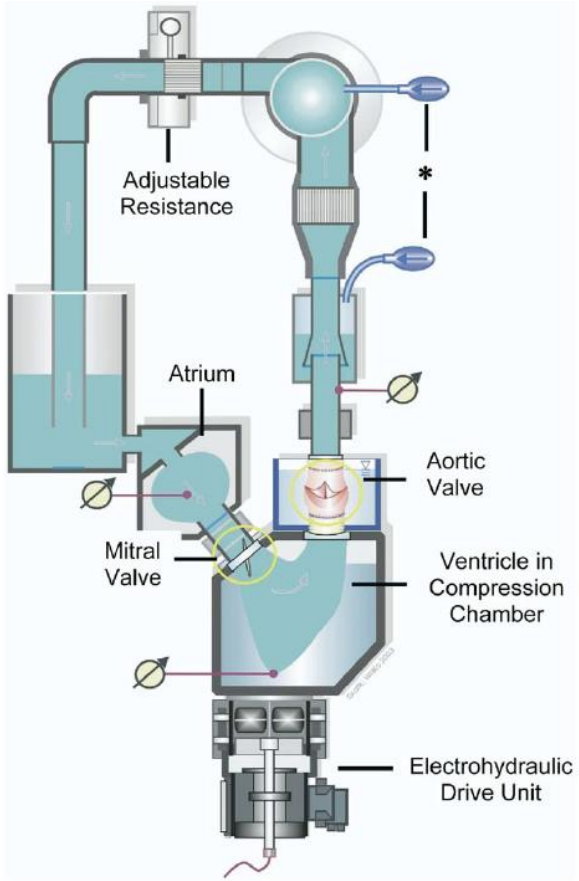
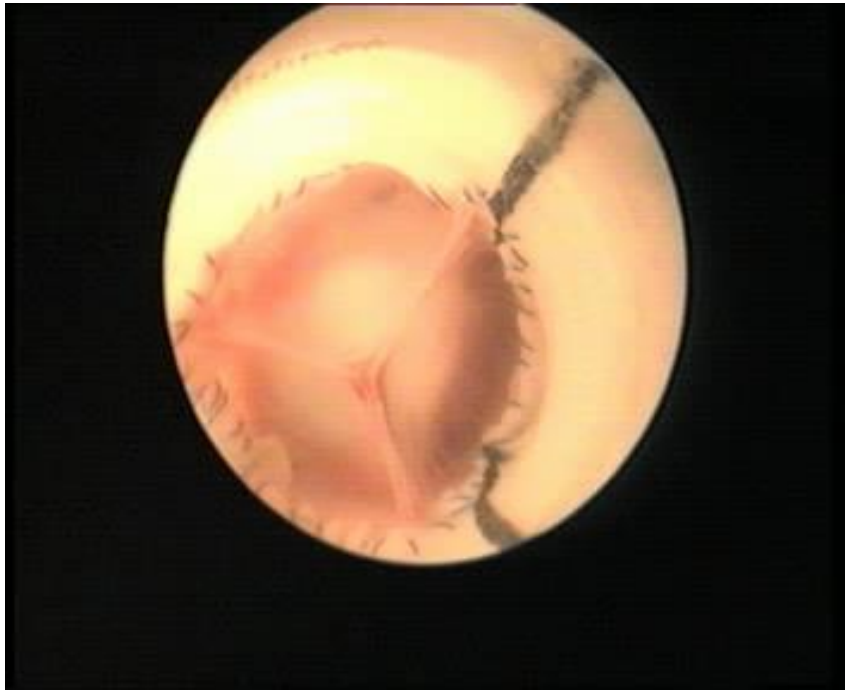



Figure 1. Schematic of the pulse duplicator. *Adjustable compliances.

Reimplantation

Remodeling



2 l/min

# Remodeling of the Aortic Root and Reconstruction of the Bicuspid Aortic Valve

Hans-Joachim Schäfers, MD, PhD, Frank Langer, MD, Diana Aicher, MD, Thomas P. Graeter, MD, and Olaf Wendler, MD

Department of Thoracic and Cardiovascular Surgery, University Hospitals Homburg, Homburg, Germany

*Background.* Currently, isolated reconstruction of a regurgitant bicuspid aortic valve can be performed with adequate early results. Dilatation of the proximal aorta is known to be associated with this valve anomaly and may be partially responsible for the development of primary regurgitation or secondary failure of valve repair. We have used repair of the bicuspid valve with remodeling of the aortic root as an alternative to insertion of a composite graft.

*Methods.* Between October 1995 and May 1999, 16 patients (12 men, 4 women, aged 35 to 73 years) were seen with a regurgitant bicuspid aortic valve and dilatation of the proximal aorta of more than 50 mm. All patients underwent repair of the valve using either coapting sutures alone (n = 12) or in combination with triangular resection of a median raphe (n = 4). Using a Dacron graft, the aortic root was remodeled and the ascending aorta (n = 16) and proximal arch (n = 4) replaced.

*Results.* No patient died. The postoperative degree of aortic regurgitation was less than grade II in all patients. Valve function has remained stable in all patients between 2 and 43 months postoperatively.

*Conclusions.* Reconstruction of the regurgitant bicuspid valve in the presence of proximal aortic dilatation is feasible with good results by combining the root remodeling technique with valve repair.

(Ann Thorac Surg 2000;70:542–6)



# Aortic root remodeling: Ten-year experience with 274 patients

Diana Aicher, MD, Frank Langer, MD, Henning Lausberg, MD, Benjamin Bierbach, MD, and Hans-Joachim Schäfers, MD

The Journal of Thoracic and Cardiovascular Surgery • October 2007

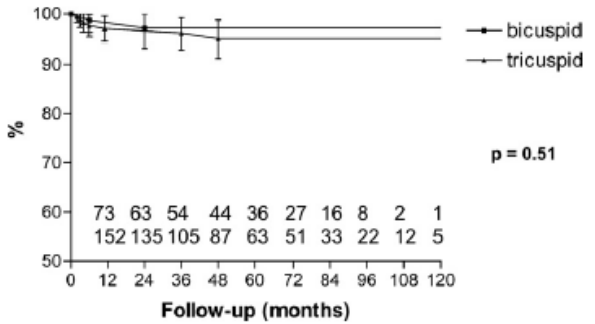



Figure 3. Actuarial freedom from reoperation of patients after remodeling analyzed by bicuspid and tricuspid valve anatomy including subjects at risk *(bottom)* and 95% confidence intervals ($P = .51$).

# Aortic Valve Reimplantation in Ascending Aortic Aneurysm: Risk Factors for Early Valve Failure

Klaus Pethig, MD, Andrea Milz, Christian Hagl, MD, Wolfgang Harringer, MD, and Axel Haverich, MD

Department of Thoracic and Cardiovascular Surgery, Division of Surgery, Hannover Medical School, Hannover, Germany

*Background.* Aortic root reconstruction by reimplantation of the native valve represents a new therapeutic option for ascending aortic aneurysms. Information about long-term follow-up is limited, and possible predictors for failure of reconstruction have not been evaluated so far.

*Methods.* After aortic valve reimplantation 101 patients were followed in a prospective observational study. From this cohort the first 75 consecutive patients with a complete 1-year follow-up were chosen for further analysis. Clinical and echocardiographic data were obtained preoperatively, intraoperatively, and early postoperatively, as well as after 1 year of follow-up.

*Results.* No mortality was observed within the first 30 days. There were 52 male patients, mean age was 49.1 ± 20.6 years, observation period was 35.6 ± 20.6 months, and Marfan's syndrome was present in 22 patients. Although in 67 patients a stable valve function could be demonstrated, 5 patients presented with mild aortic insufficiency or had to be operated on again for secondary valve failure (n = 3). Analyzing possible demographic, disease-related, and procedure-related risk factors in a multivariable approach, only level of coaptation within the graft (as assessed by echocardiography) could be identified as being related to the subsequent development of aortic insufficiency. Coaptation level within the tube graft (type A) resulted in a mean aortic regurgitation grade of 0.3 ± 0.5 as compared with a mean grade of 2.5 ± 0.6 for a coaptation type C (below the prosthesis; $p < 0.001$).

*Conclusions.* Aortic valve reimplantation is a promising alternative to alloprosthetic composite replacement. A level of coaptation within the tube graft is essential to achieve valve competence.

(Ann Thorac Surg 2002;73:29–33)



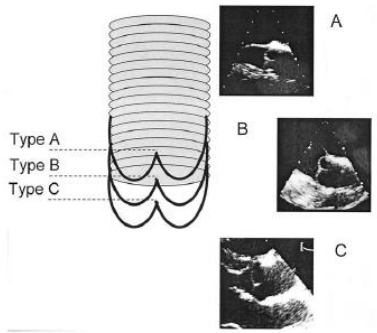



*Fig 1. Type of coaptation of the aortic valve as assessed by echocardiography. Type A has the coaptation point ≥ 2 mm within the prosthesis. Type B has coaptation close to the lower border of the Dacron graft. Type C has coaptation ≥ 2 mm below the prosthesis.*

# Preservation of the Bicuspid Aortic Valve

Hans-Joachim Schäfers, MD, PhD, Diana Aicher, MD, Frank Langer, MD, and Henning F. Lausberg, MD

Department of Thoracic and Cardiovascular Surgery, University Hospitals of Saarland, Homburg/Saar, Germany

*Background.* Bicuspid anatomy of the aortic valve is a common reason for aortic regurgitation and is associated with aortic dilatation in more than 50% of patients. We have observed different patterns of aortic dilatation and used different approaches preserving the valve.

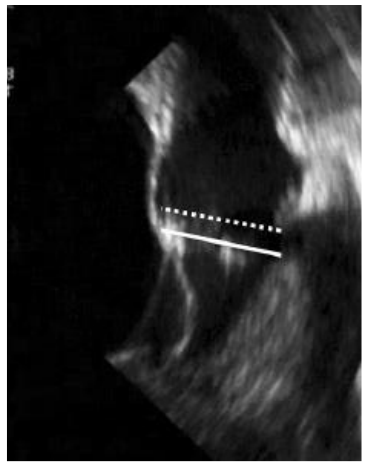
*Methods.* Between October 1995 and February 2006, a regurgitant bicuspid valve was repaired in 173 patients. The aorta was normal in 57 patients who underwent isolated repair. Aortic dilatation mainly above commissural level (n = 38) was treated by separate valve repair plus supracommissural aortic replacement. In 78 patients, aortic dilatation involved the root and was treated by root remodeling.

*Results.* Hospital mortality and perioperative morbidity were low in all three groups. Myocardial ischemia was significantly shorter in repair plus aortic replacement than remodeling ($p < 0.001$). Freedom from aortic regurgitation II or greater at 5 years varied between 91% and 96%. Freedom from reoperation at 5 years was 97% after remodeling, but only 53% after repair plus aortic replacement ($p = 0.33$). Symmetric prolapse was the most frequent cause for reoperation.

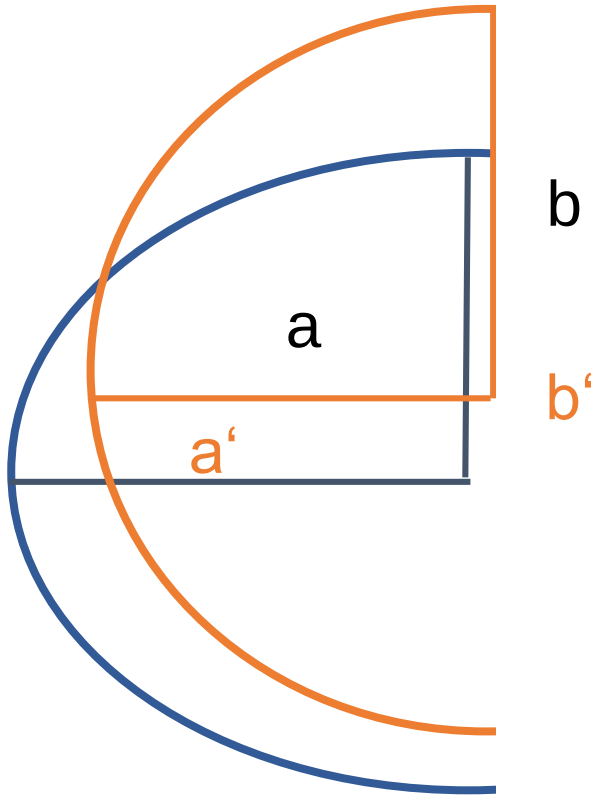
*Conclusions.* The long-term stability of bicuspid aortic valve repair is excellent in the absence of aortic pathology. In the presence of aortic dilatation, root remodeling leads to equally stable valve durability. In patients with less pronounced root dilatation, separate valve repair plus aortic replacement may be a less complex alternative. Symmetric prolapse should be avoided if the ascending aorta is replaced.

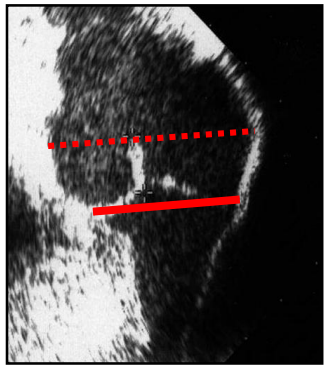
(Ann Thorac Surg 2007;83:S740–5)





# Reduction of STJ and Cusp Prolapse

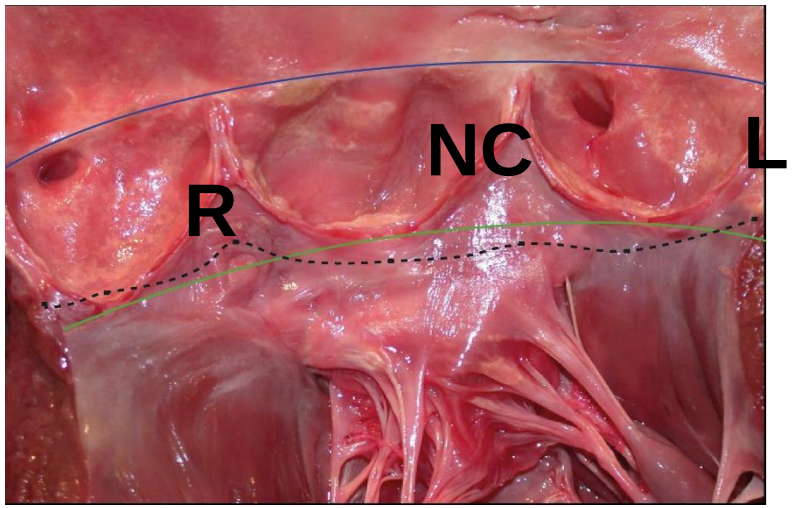


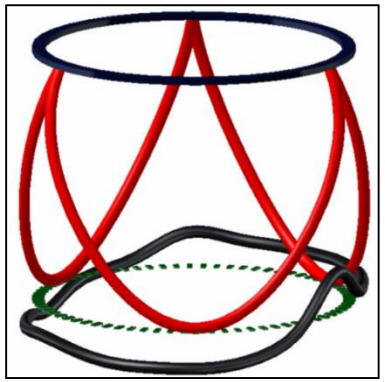



$$C_E = \pi \times \left[3/2 \times (a+b) - \sqrt{a \times b}\right]$$

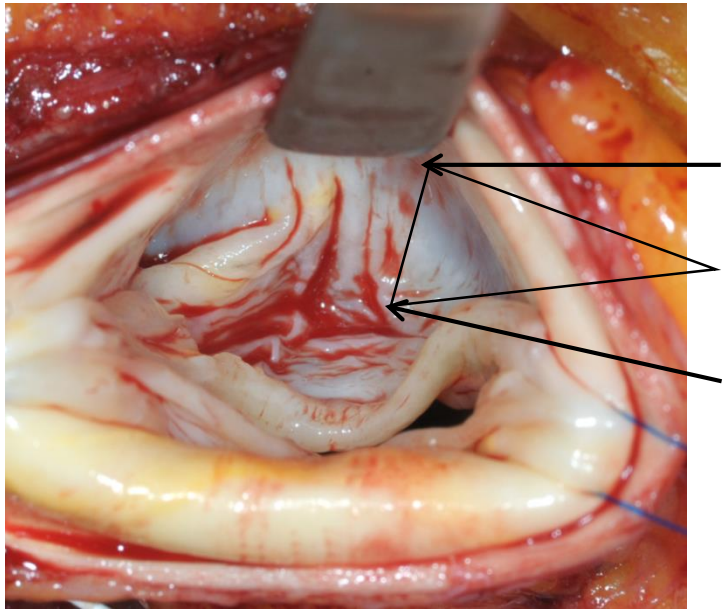
$$b \approx r_{aorta}$$
$$a \approx r_{cusp} \quad \Longrightarrow \quad r_{cusp} \approx 1 / r_{aorta}$$

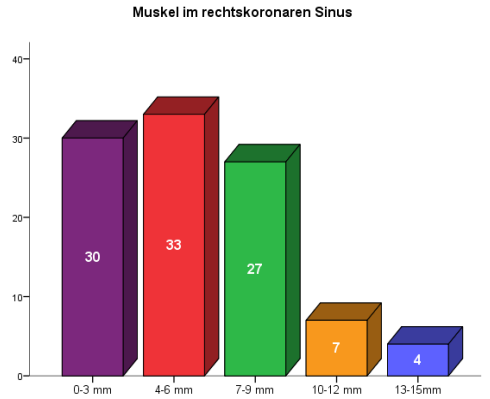
# Functional Aortic Annulus / Basal Ring



Lansac E et al. ATS 2015

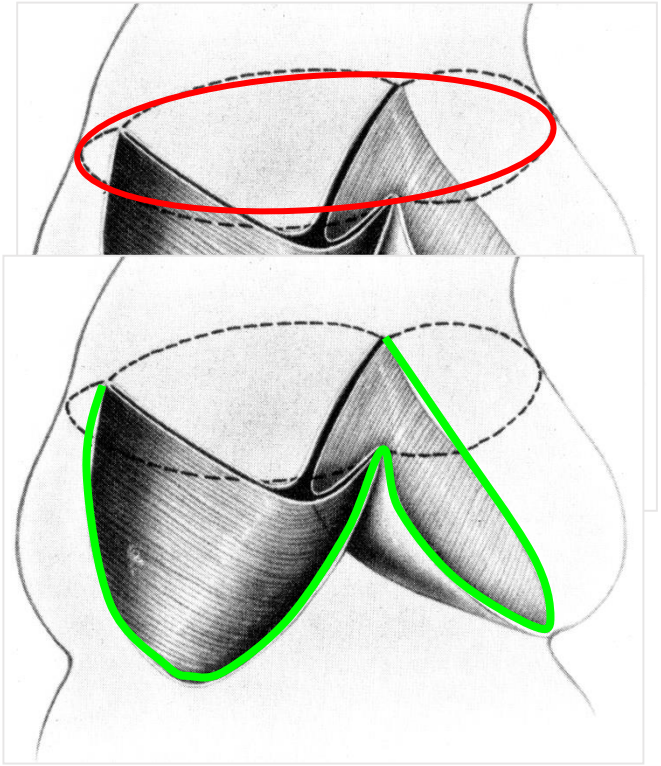



De Kerchove et al, EJCTS 2018

# Aortic Valve Repair - Difficulties

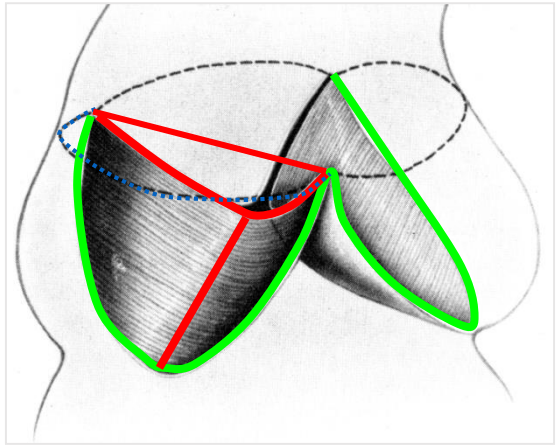
Dimensions- of aortic root/(ring)



# Aortic Valve Repair - Difficulties

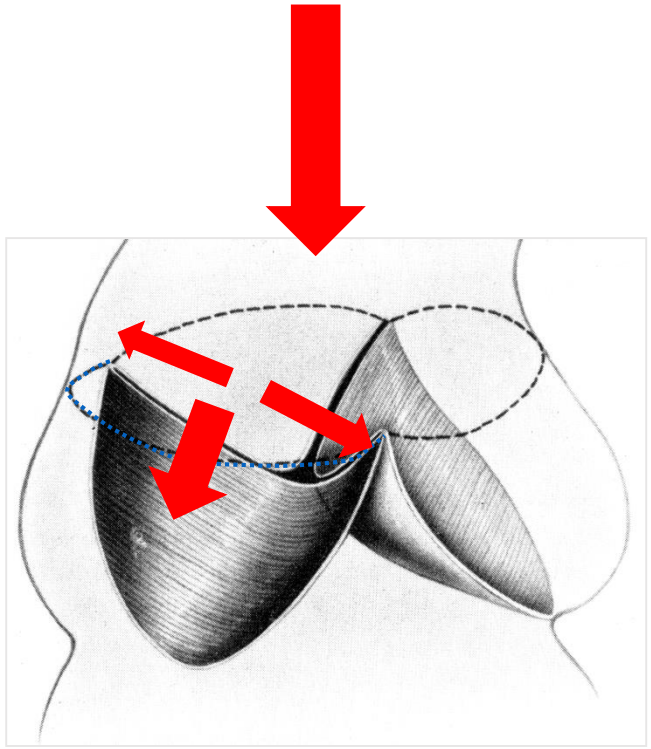
Configuration/coaptation of cusps

Vision from outflow



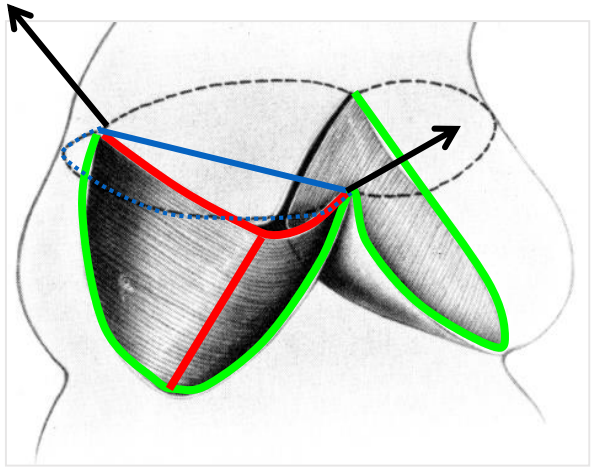
# Aortic Valve Repair - Difficulties

Geometry altered by non-pressurized state

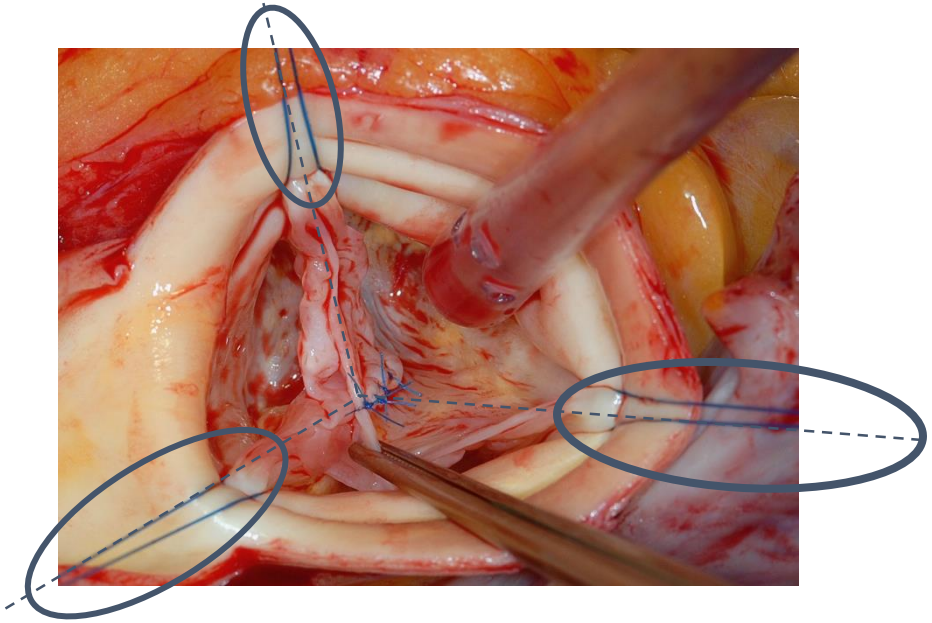


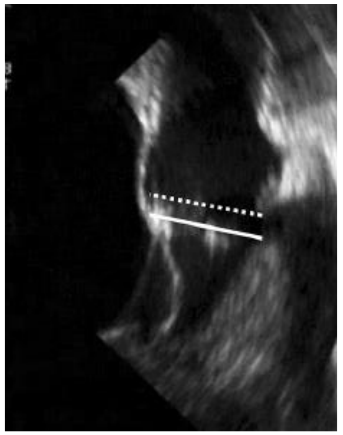
# Solutions

Geometry altered by non-pressurized state!



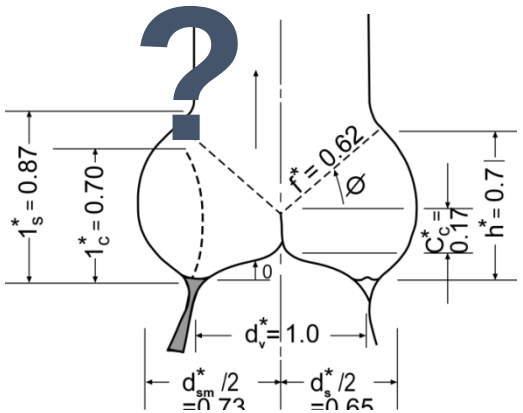
Stay sutures!





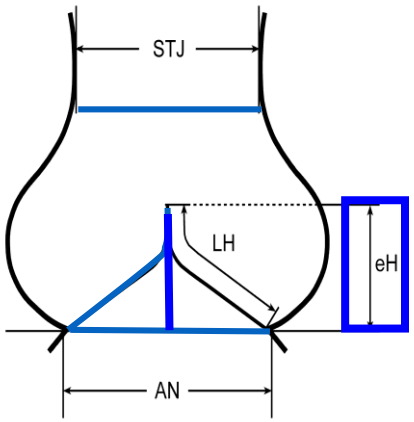
# Aortic Valve Repair - Assessment

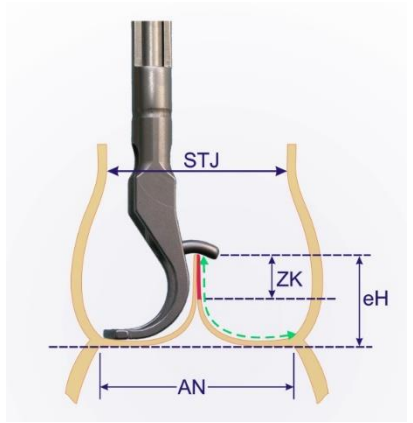
## Solutions

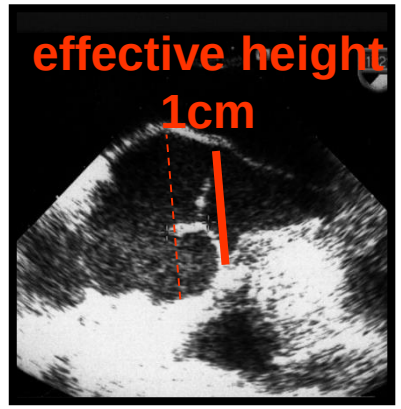



Swanson, Circ Res 1974

### Configuration/coaptation of cusps



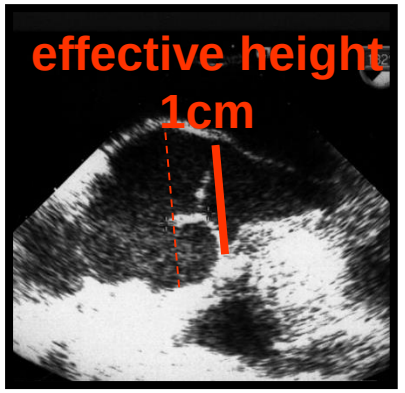




**A new approach to the assessment of aortic cusp geometry**

Hans-Joachim Schäfers, MD, PhD, Benjamin Bierbach, MD, and Diana Aicher, MD, Homburg/Saar, Germany

# Effective Height

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European Journal of Cardio-thoracic Surgery 38 (2010) 400—406

CARDIO-THORACIC SURGERY

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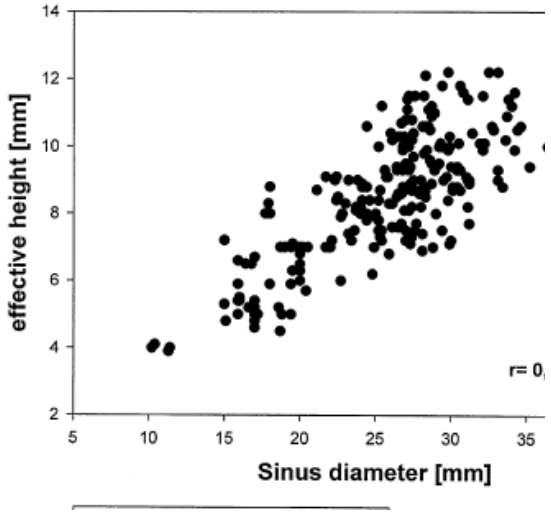
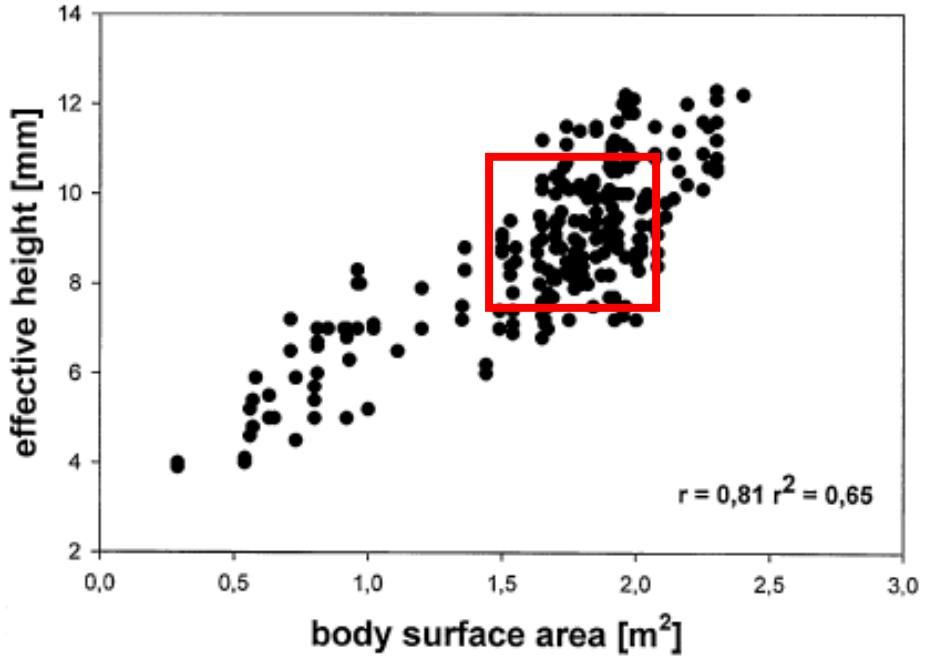
## Aortic root and cusp configuration determine aortic valve function☆

Benjamin Oliver Bierbach [a], Diana Aicher [a], Omar Abu Issa [a], Hagen Bomberg [a], Stefan Gräber [b], Petra Glombitza [a], Hans-Joachim Schäfers [a,*]

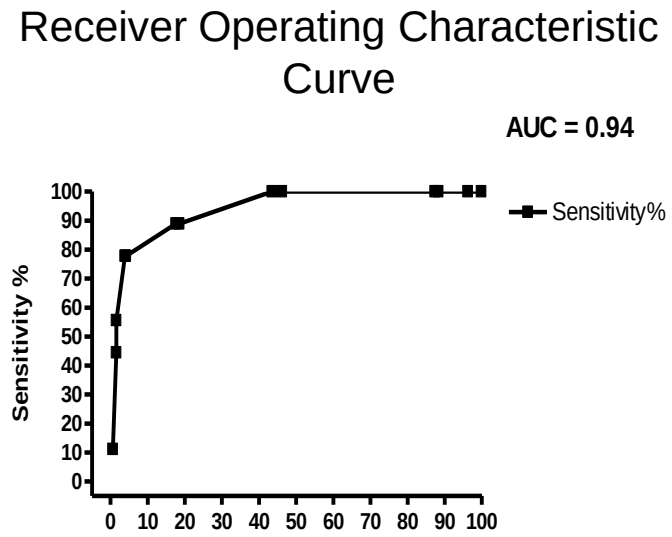
[a] Department of Thoracic and Cardiovascular Surgery, University Hospitals of Saarland, Kirrbergerstrasse 1, 66421 Homburg/Saar, Germany
[b] Institute for Medical Biometry, Epidemiology and Informatics, University Hospitals of Saarland, Homburg/Saar, Germany



# Aortic Valve Repair

Hypothesis: eH ≥ 9mm = predictor of near-normal av function




497 patients with eH ≥ 9mm

| | |
|---|---|
| No / trivial AR: | 235 patients |
| Mild AR : | 186 patients |
| Moderate AR: | 2 patients |

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European Journal of Cardio-thoracic Surgery 38 (2010) 400—406

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Aortic root and cusp configuration determine aortic valve function☆

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[a] Department of Thoracic and Cardiovascular Surgery, University Hospitals of Saarland, Kirrbergerstrasse 1, 66421 Homburg/Saar, Germany
[b] Institute for Medical Biometry, Epidemiology and Informatics, University Hospitals of Saarland, Homburg/Saar, Germany

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DOI:10.1016/j.jcmg.2009.04.013

# Mechanisms of Recurrent Aortic Regurgitation After Aortic Valve Repair

## Predictive Value of Intraoperative Transesophageal Echocardiography

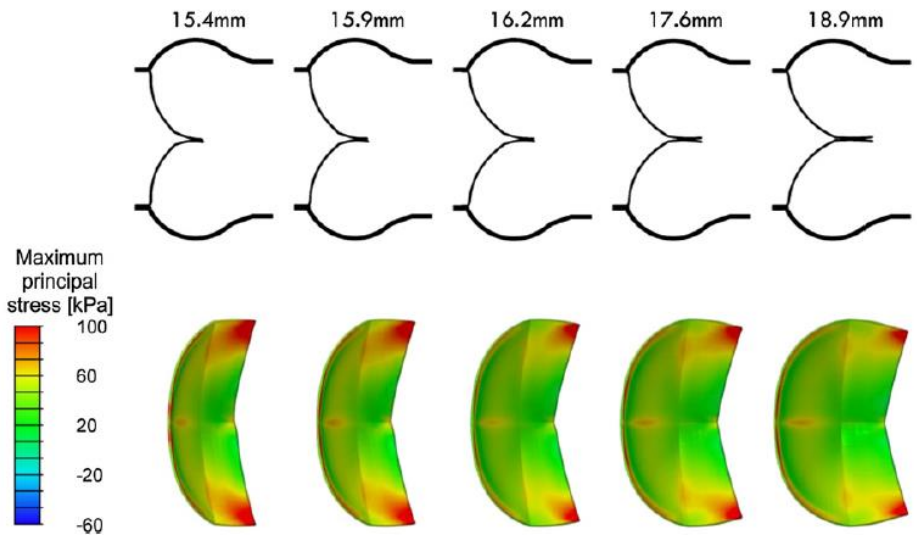
**Table 3. Pre-Operative and Intraoperative TEE Measurements of the Study Population**

| | No/Trivial AR (n = 122) | 1+ to 2+ AR (n = 23) | ≥3+ AR (n = 41) | p Value (F or Chi-Square) |
|---|---|---|---|---|
| Pre-operative (mm) | | | | |
| Aortic annulus | 25.4 ± 4.1 | 23.7 ± 3.5 | 25.8 ± 5.9 | 0.27 |
| Sinus of Valsalva | 39.4 ± 7.6 | 39.0 ± 8.6 | 41.0 ± 13.4 | 0.61 |
| Sino-tubular junction | 34.8 ± 8.9 | 34.7 ± 8.6 | 34.1 ± 8.9 | 0.93 |
| Ascending aorta | 41.6 ± 11.4 | 39.5 ± 8.2 | 37.2 ± 12.6 | 0.14 |
| Height of the sinus | 25.3 ± 7.5 | 25.4 ± 5.8 | 27.3 ± 11.5 | 0.64 |
| Symmetry of coaptation | 1.9 ± 2.2 | 2.3 ± 1.9 | 2.2 ± 2.3 | 0.23 |
| Post-operative | | | | |
| Aortic annulus (mm) | 21.4 ± 3.8 | 21.0 ± 3.5 | 25.7 ± 4.4 | <0.001 |
| Sinus of Valsalva (mm) | 29.1 ± 5.3 | 29.6 ± 5.0 | 31.4 ± 5.4 | 0.04 |
| Sino-tubular junction (mm) | 25.6 ± 4.1 | 23.9 ± 3.7 | 27.2 ± 3.8 | <0.01 |
| Ascending aorta (mm) | 27.4 ± 5.1 | 27.7 ± 5.2 | 28.4 ± 4.6 | 0.47 |
| Coaptation length (mm) | 6.6 ± 2.8 | 3.2 ± 1.4 | 2.2 ± 1.6 | <0.001 |
| Coaptation length <4 mm (%) | 11 | 52 | 85 | <0.001 |
| Cusp to annulus distance (mm) | −1.2 ± 2.8 | −1.5 ± 3.2 | −3.9 ± 4.8 | <0.001 |
| Distance from tips to annulus (mm) | 6.9 ± 4.3 | 3.0 ± 3.1 | 0.6 ± 4.2 | <0.001 |
| Tips below the aortic annulus (%) | 4 | 13 | 49 | <0.001 |
| Vena contracta width (mm) | 0.6 ± 1.1 | 2.4 ± 1.7 | 2.6 ± 1.4 | <0.001 |
| Eccentric jet (%) | 9 | 30 | 73 | <0.001 |

# Higher effective height leads to improved coaptation height

## Aortic root numeric model: Correlation between intraoperative effective height and diastolic coaptation

Gil Marom, MSc,[a] Rami Haj-Ali, PhD,[a] Moshe Rosenfeld, DSc,[a] Hans Joachim Schäfers, MD,[b] and Ehud Raanani, MD,[c] Tel Aviv and Tel Hashomer, Israel; and Homburg, Germany



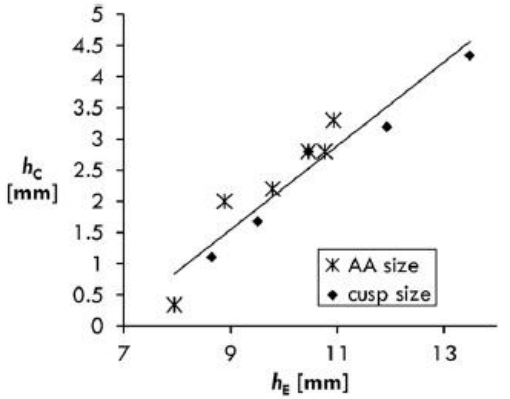
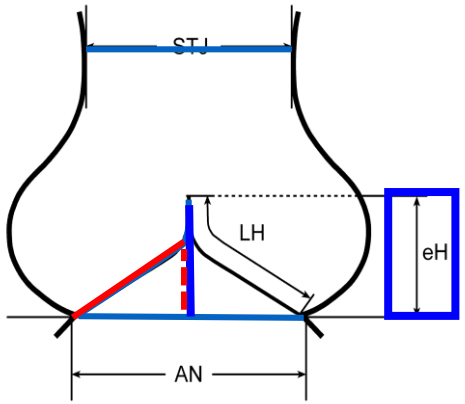
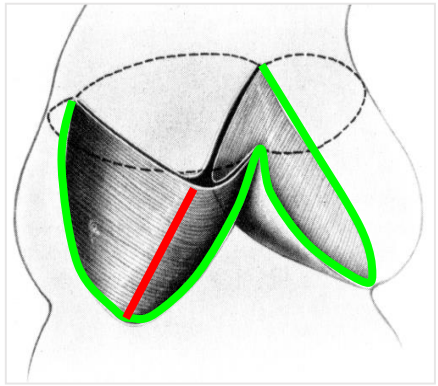




**FIGURE 2.** The average coaptation heights ($h_C$) as a function of the effective height ($h_E$). *AA*, Aortic annulus.

J Thorac Cardiovasc Surg 2013;145:303-4

# Configuration/coaptation of cusps



## Cusp height in aortic valves

Hans-Joachim Schäfers, MD,[a] Wolfram Schr

**Objectives:** Successful aortic valve repair
available on the normal dimensions of hun

**Methods:** The cusp height was measured i
A tricuspid anatomy was present in 329 pa
height, weight, preoperative degree of aorti
analyzed for possible interrelation betwee

**Results:** In the bicuspid valves, the geomet
± 2.0). Significant correlations were found
valves, the height of the noncoronary cusp
left coronary cusp varied from 12 to 25 m
to 25 mm (mean, 20.0 ± 2.1). The noncoron
cusp ($P = .000$). No difference was found
between the geometric height and clinical
degree of aortic regurgitation.

**Conclusions:** We found the cusp height wa
correlates with the clinical variables. Thes
repair. (J Thorac Cardiovasc Surg 2012;

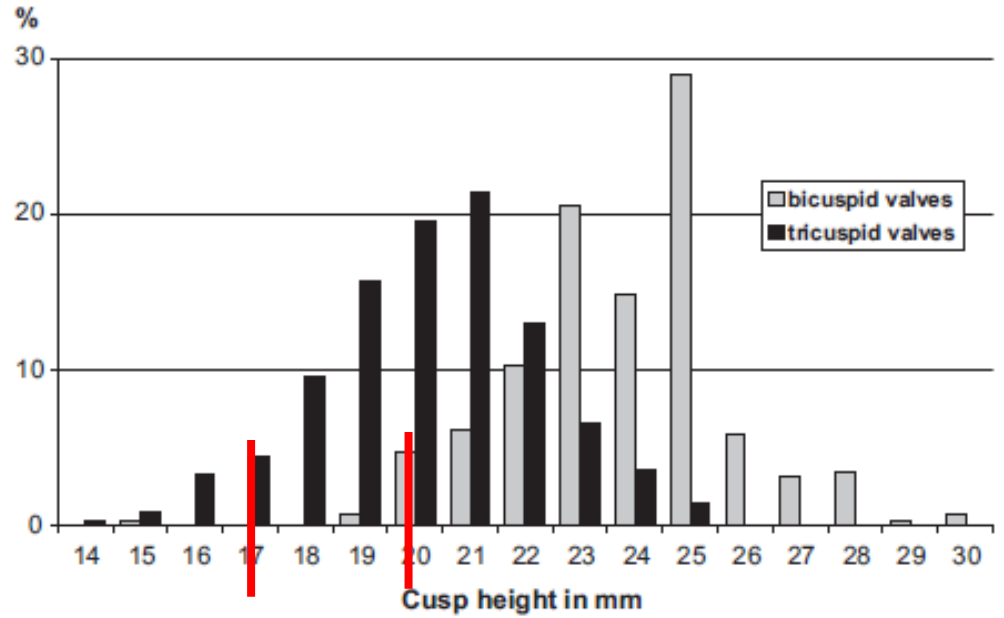
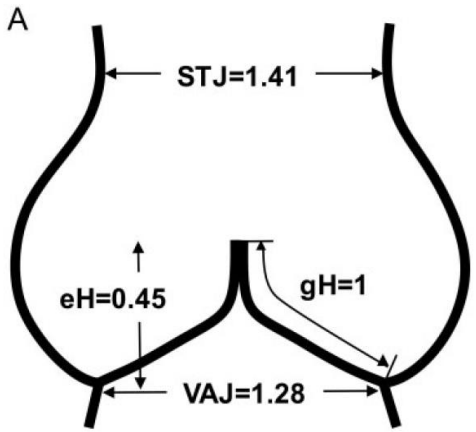


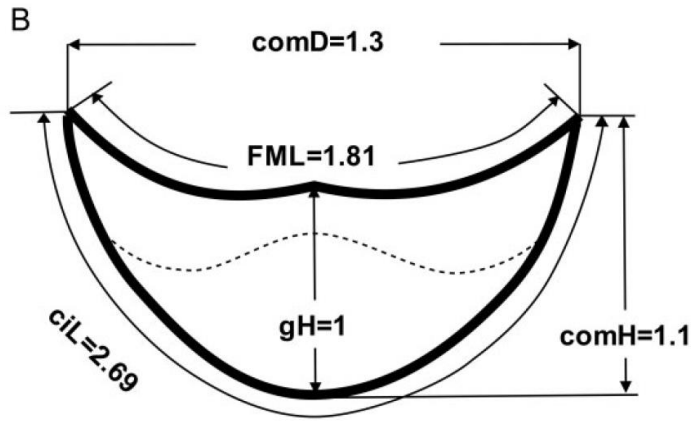

**FIGURE 3.** Distribution of geometric height in bicuspid (n = 289; nonfused cusps) and tricuspid (n = 332; mean of all 3 cusps) aortic valves.

# Free margin length and coaptation surface area in normal tricuspid aortic valve: an anatomical study

Laurent De Kerchove[a,b,*], Mona Momeni[c], Gaby Aphram[a,b], Christine Watremez[c], Xavier Bollen[d], Ramadan Jashari[e], Munir Boodhwani[f], Parla Astarci[a,b], Philippe Noirhomme[a,b] and Gebrine El Khoury[a,b]

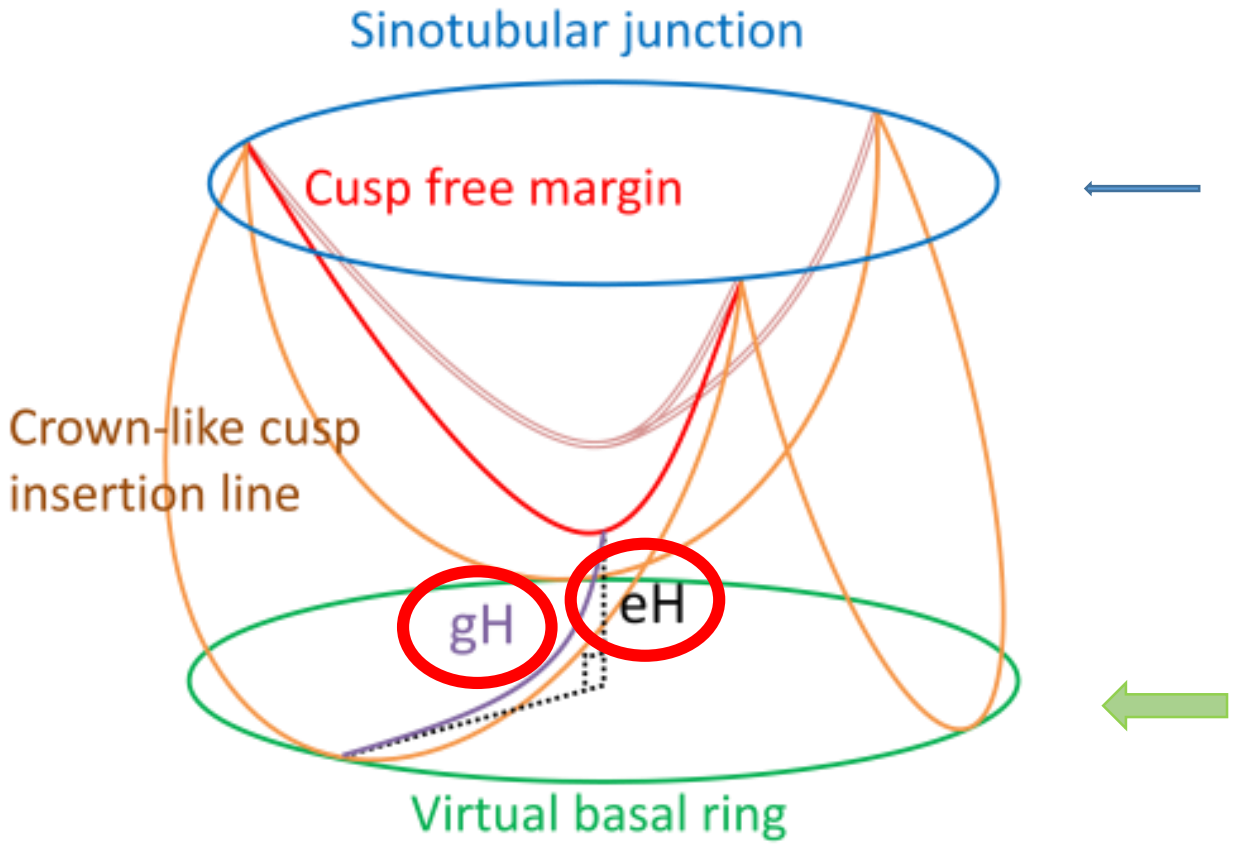
European Journal of Cardio-Thoracic Surgery 53 (2018) 1040–1048



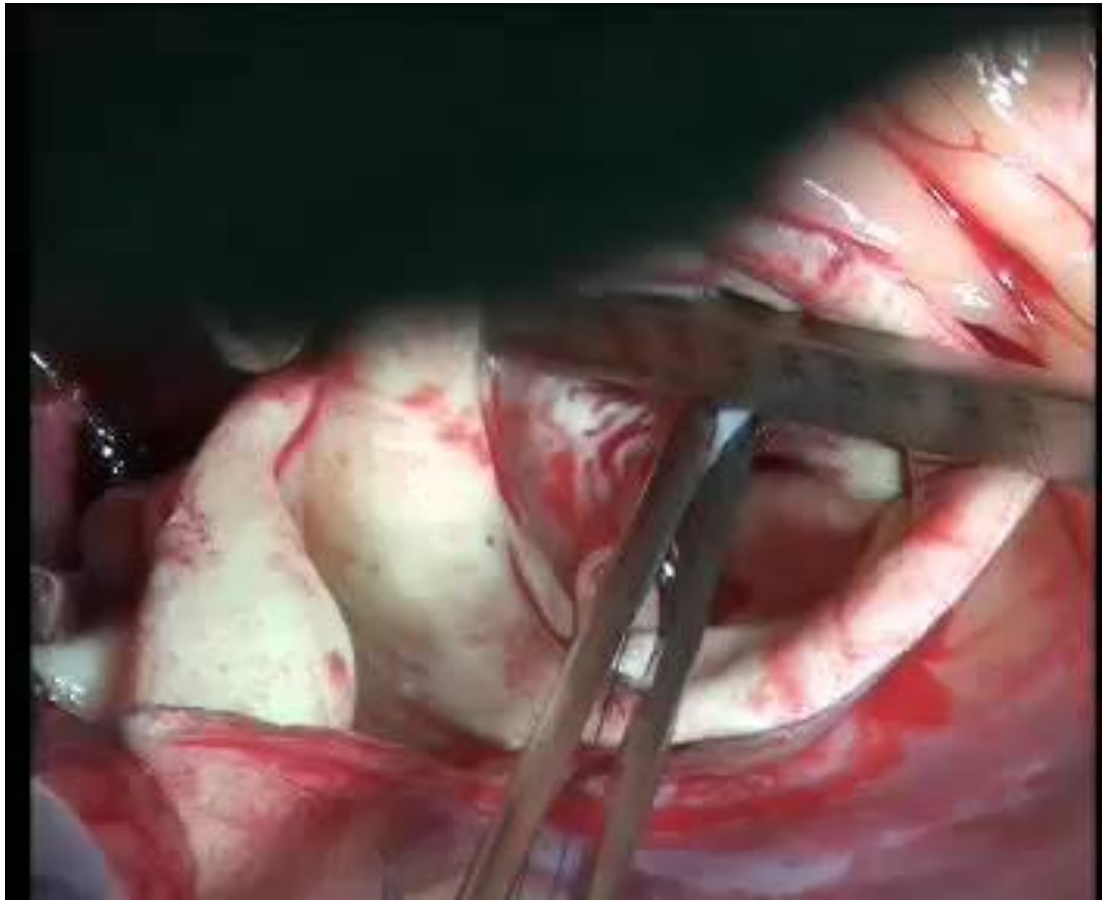

| | | | |
|---|---|---|---|
| Commissure height (mm), mean ± SD | 20.7 ± 1.5 | 18.0–25.3 | 0.013[c] |
| N/L commissure | 20.6 ± 1.5 | N/L vs L/R | 0.18[d] |
| L/R commissure | 19.7 ± 1.5 | L/R vs R/N | 0.005[d] |
| R/N commissure | 21.8 ± 2.1 | R/N vs N/L | 0.077[d] |
| Commissure distance (mm), mean ± SD | 24.6 ± 2.7 | 13.5–32 | 0.091[c] |
| NC | 24.7 ± 3.6 | | |
| LC | 23.4 ± 3.1 | | |
| RC | 25.7 ± 2.9 | | |
| Geometric height (mm), mean ± SD | 18.9 ± 1.5 | 15.7–23.3 | 0.80[e] |
| NC | 19.0 ± 1.7 | | |
| LC | 19.0 ± 1.7 | | |
| RC | 18.7 ± 1.9 | | |

# Aortic Valve Assessment



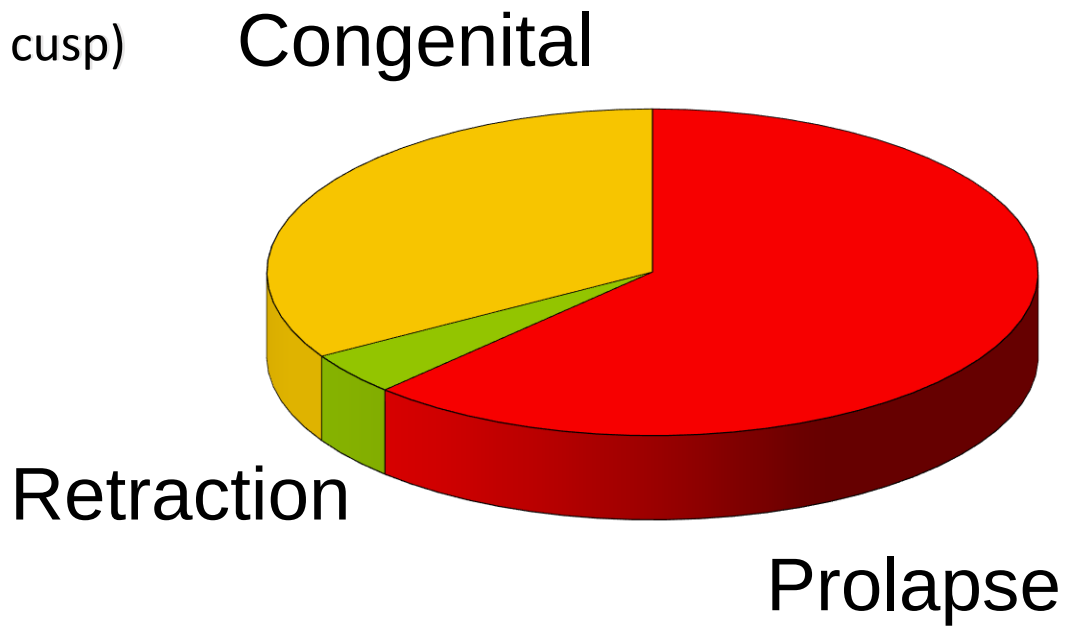

„Golden Rule“: eH=gH x 0.45

# Aortic Valve Repair - Assessment

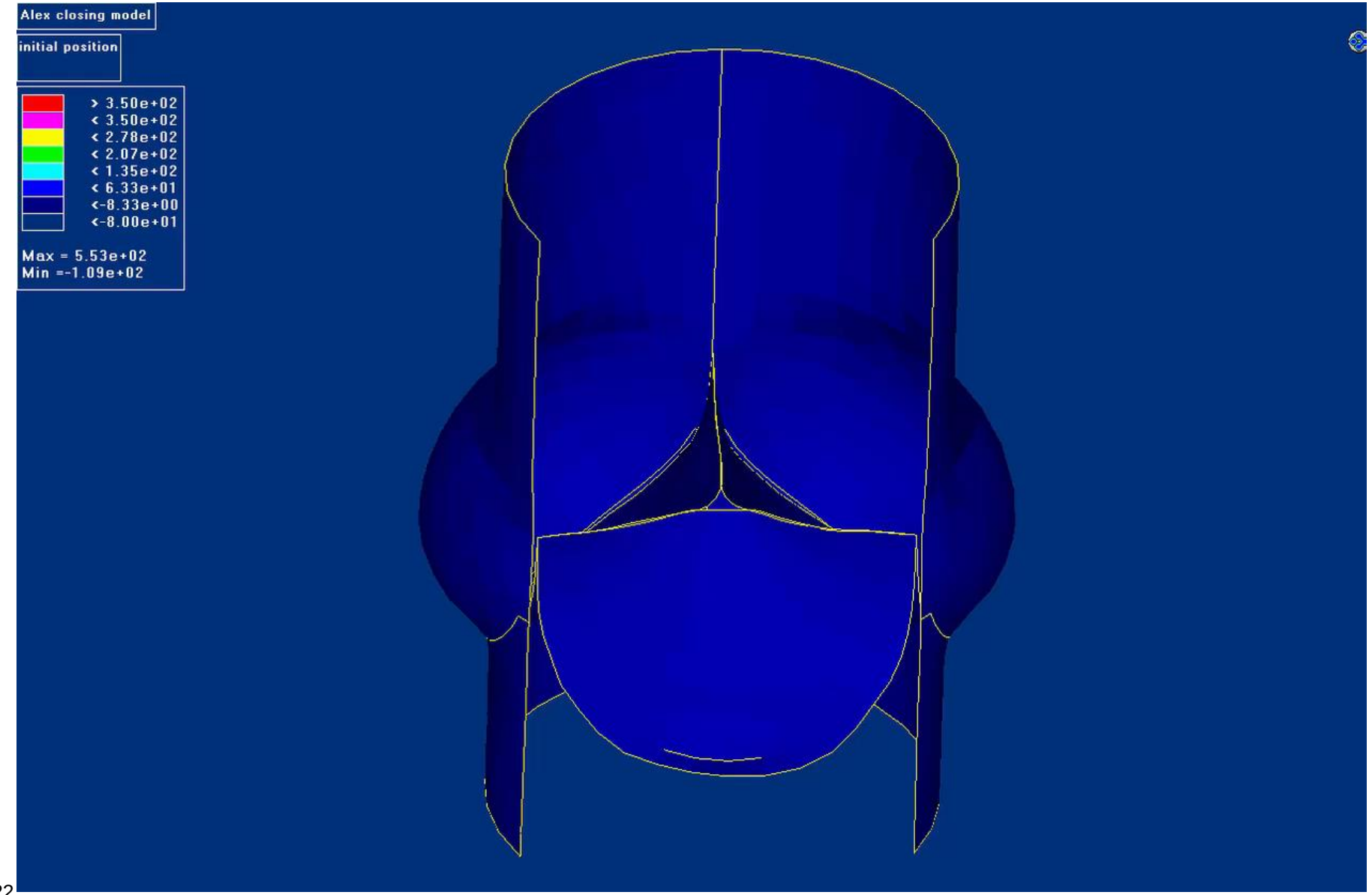


# Causes of Cusp Pathology

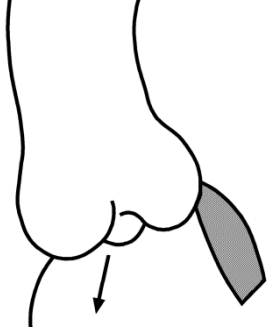
- Prolapse n=606/826 =73%
  (right > non > left-coronary cusp)
- Congenital malformation
  - bicuspid n=276
  - unicuspid n =50
  - quadricuspid n =3
- Retraction / Calcium n=42



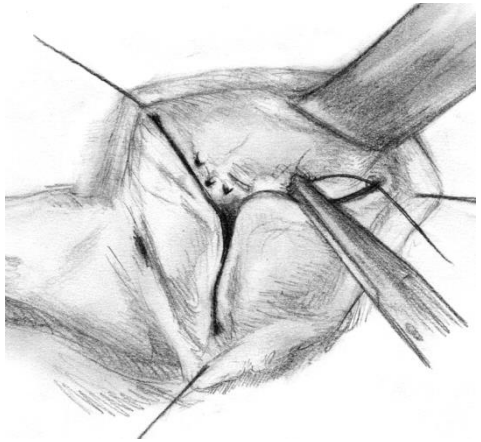
# Aortic Valve – Stress Distribution



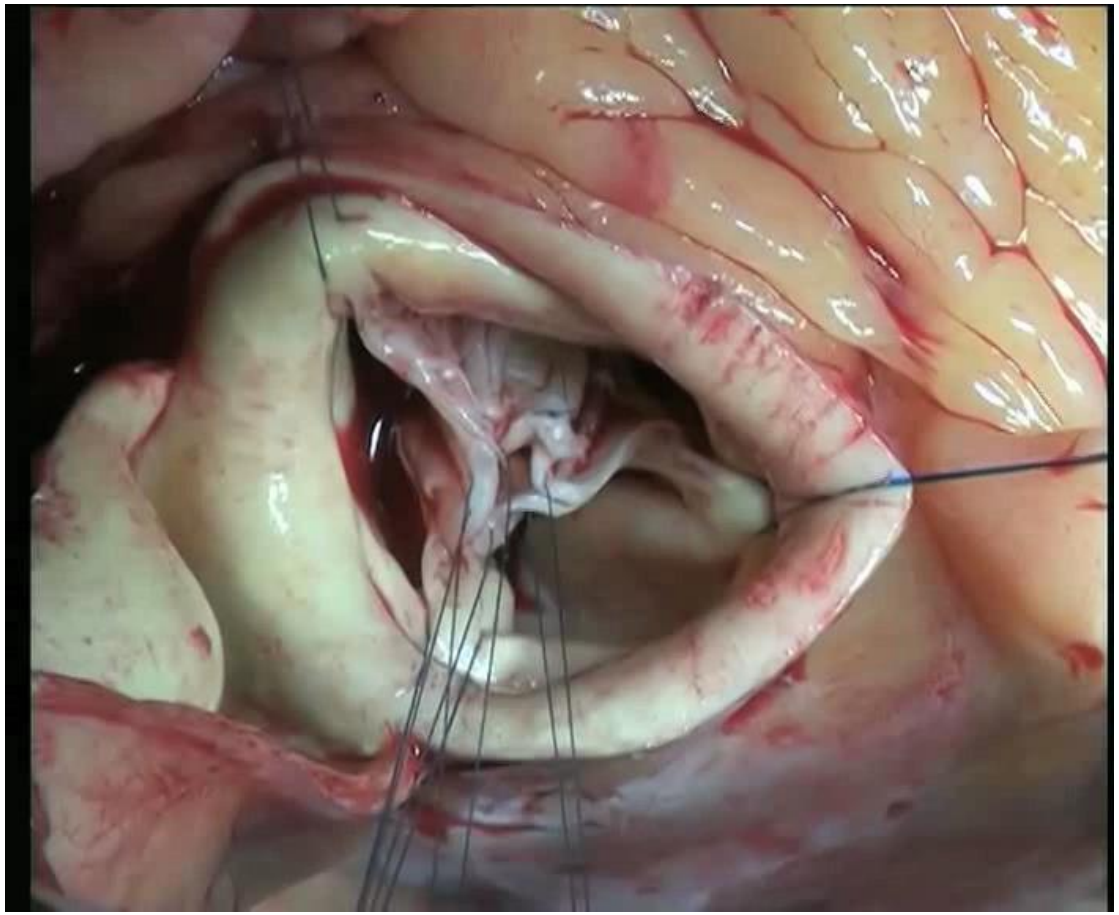
# Reconstructive Techniques



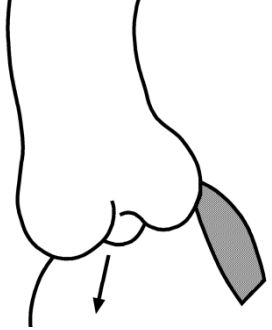
Prolapse



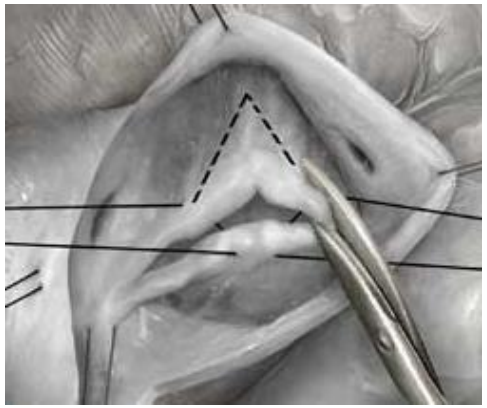
Plication of
Cusp Margin



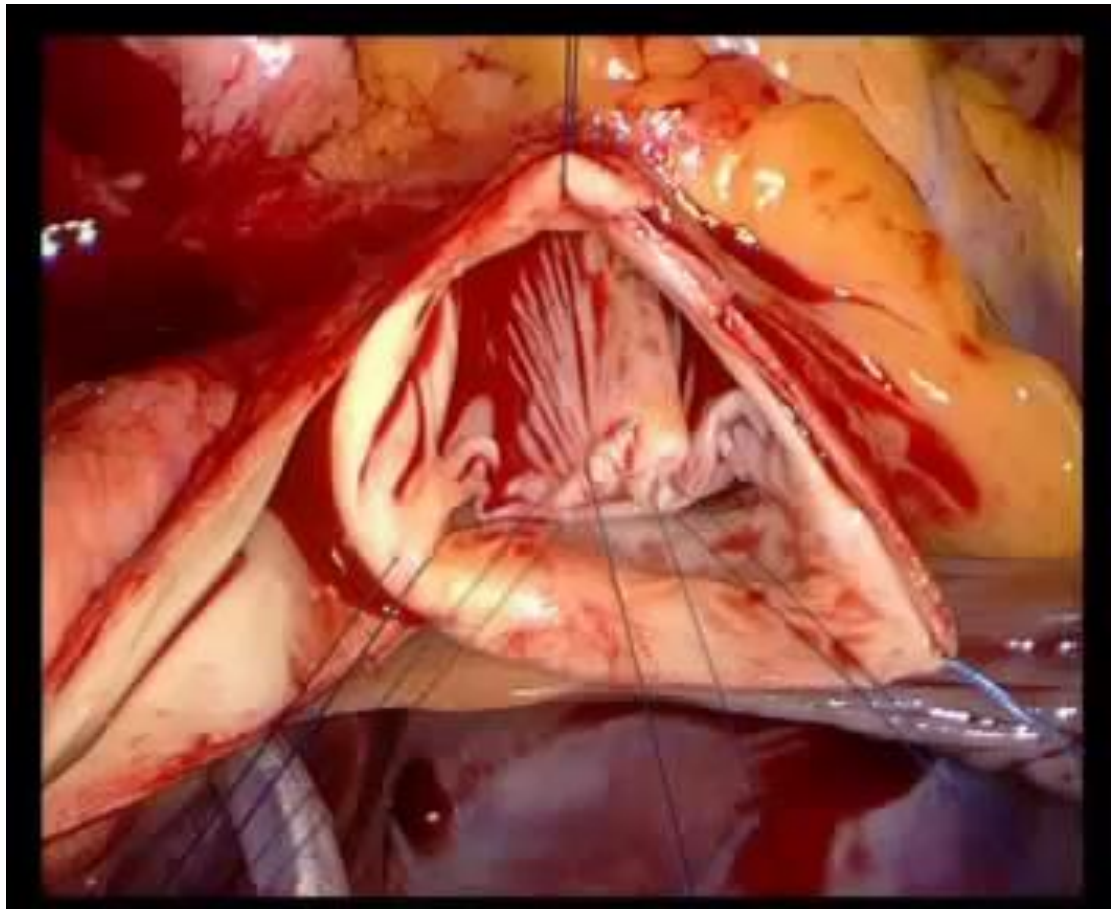
# Reconstructive Techniques



Fibrosis,
Calcium,
Redundancy

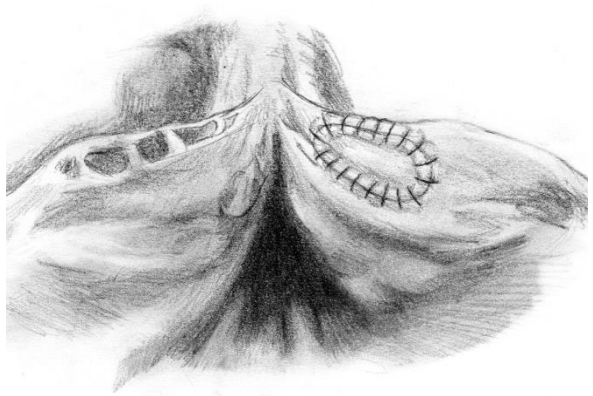


Triangular
Resection

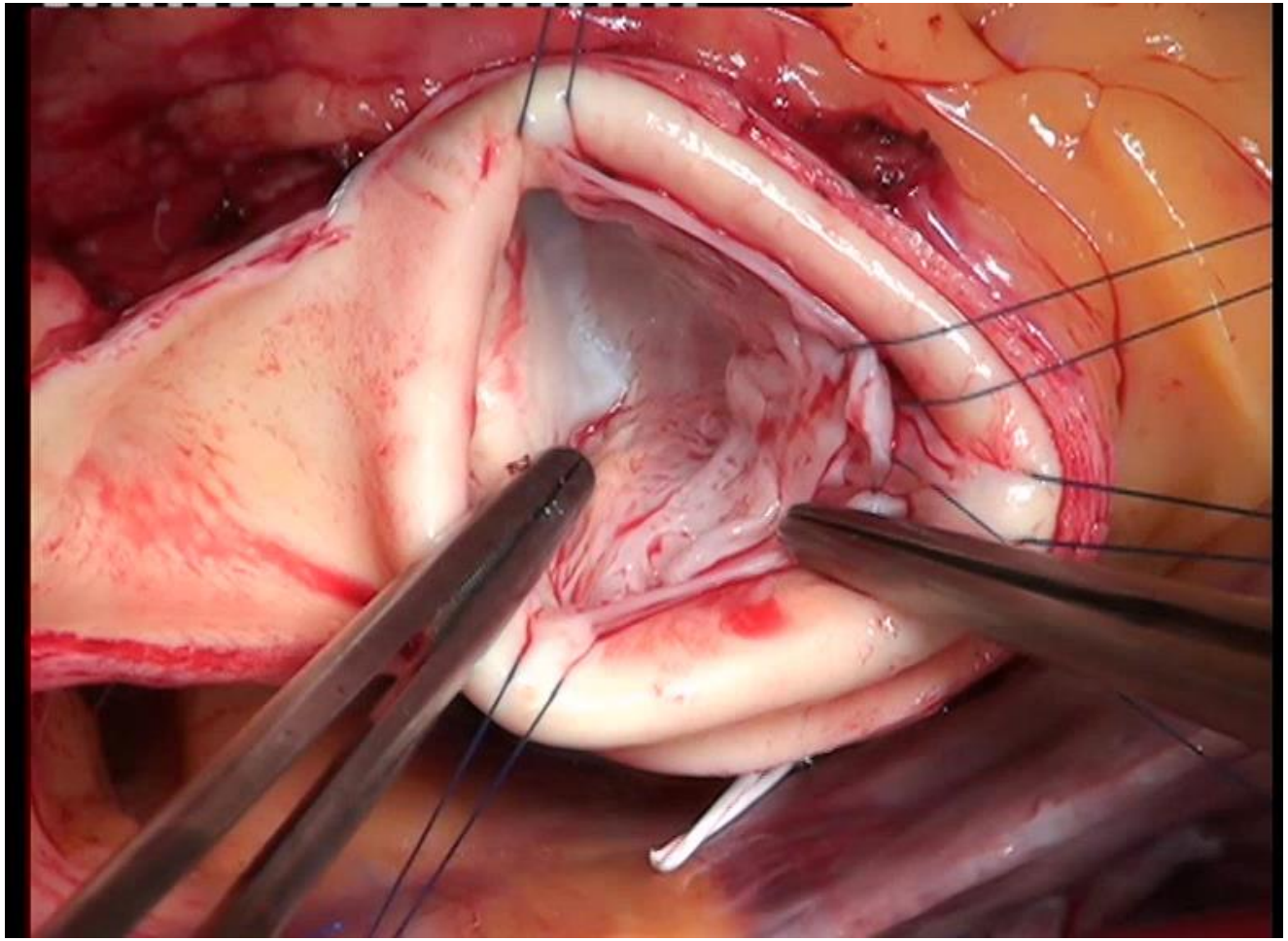


# Reconstructive Techniques

Fenestration



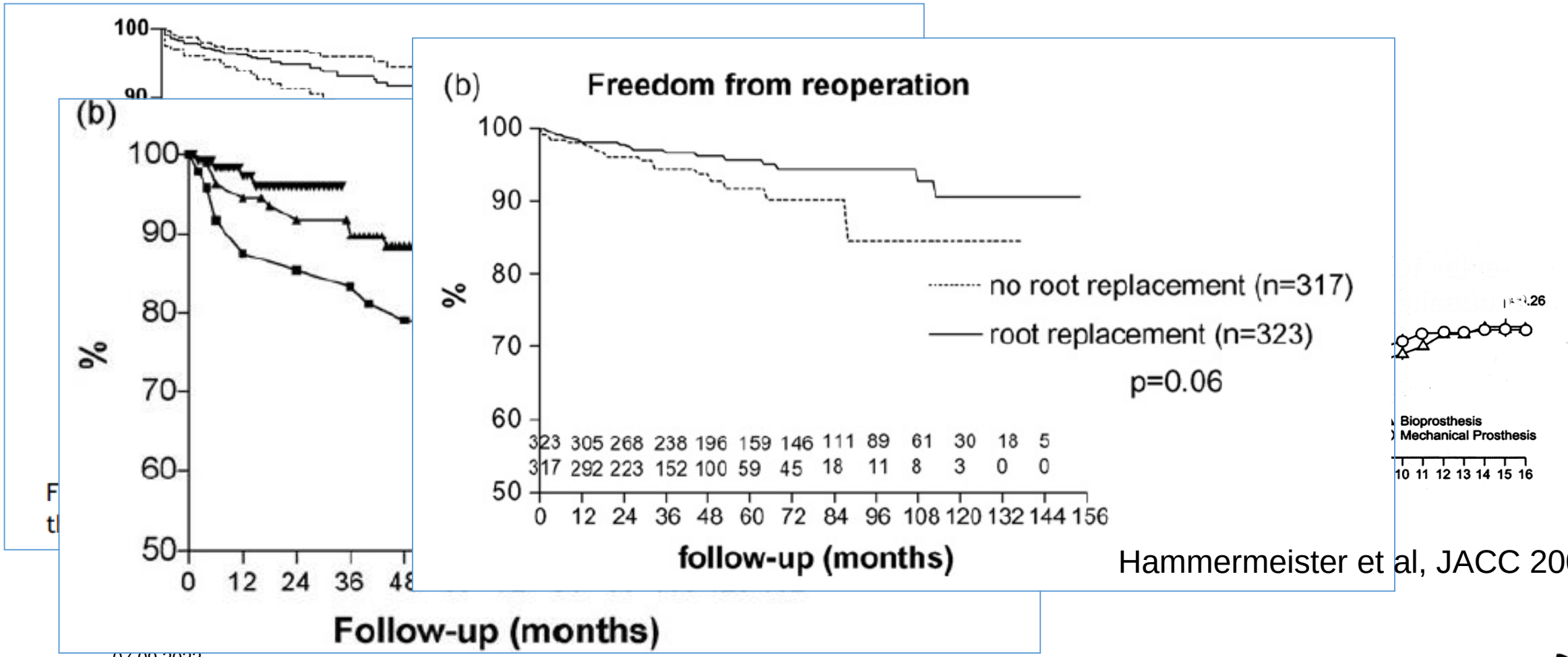
Stabilisation of
cusp (pericardium)



ELSEVIER
European Journal of Cardio-thoracic Surgery 37 (2010) 127–132
www.elsevier.com/locate/ejcts

# Aortic valve repair leads to a low incidence of valve-related complications

Diana Aicher [a], Roland Fries [b], Svetlana Rodionycheva [a], Kathrin Schmidt [a], Frank Langer [a], Hans-Joachim Schäfers [a,*]

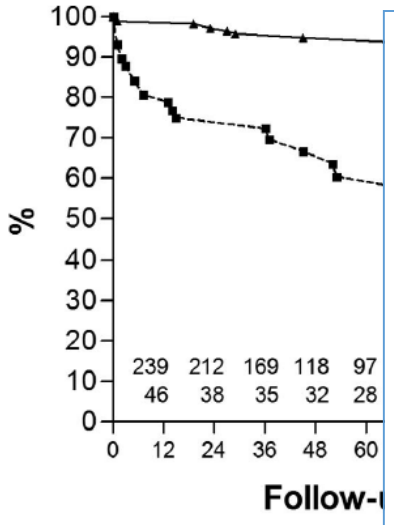


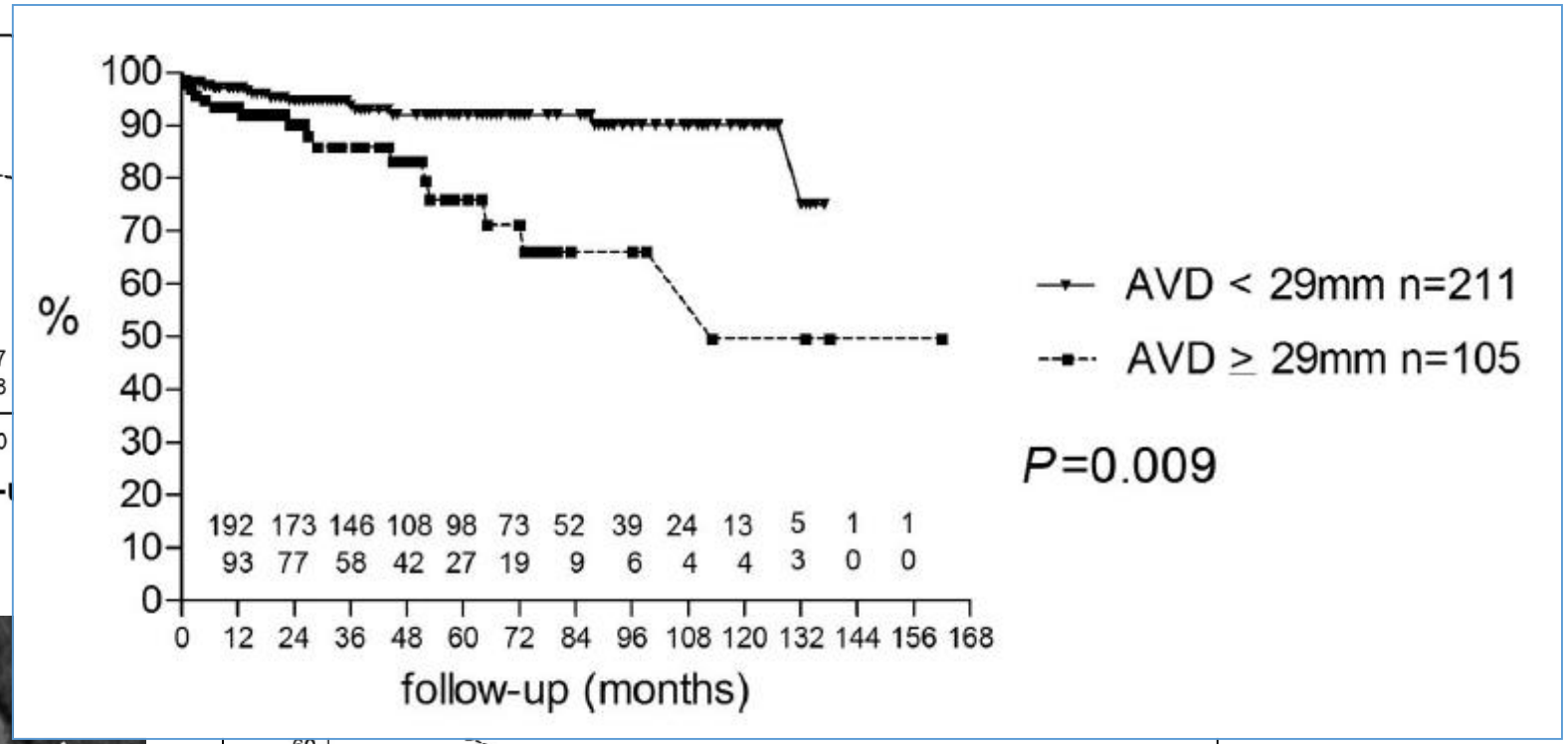

Hammermeister et al, JACC 2000

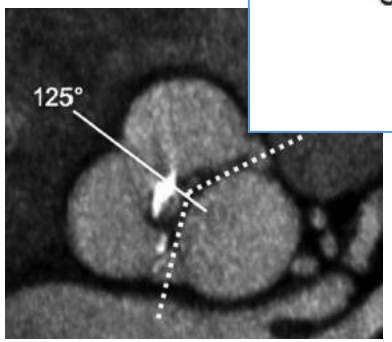
# Valve Configuration Determines Long-Term Results After Repair of the Bicuspid Aortic Valve

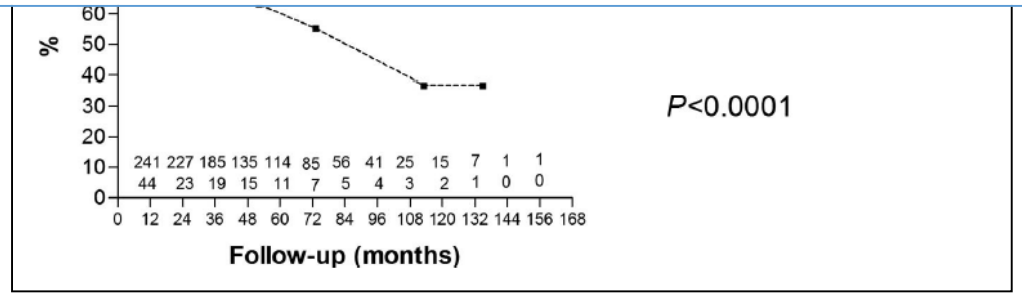
Diana Aicher, MD; Takashi Kunihara, MD; Omar Abou Issa, MD; Brigitte Brittner, MD; Stefan Gräber, MD; Hans-Joachim Schäfers, MD

*Circulation* **January 18, 2011**



# Annular dilatation effects coaptation

## Aortic root numeric model: Annulus diameter prediction of effective height and coaptation in post–aortic valve repair

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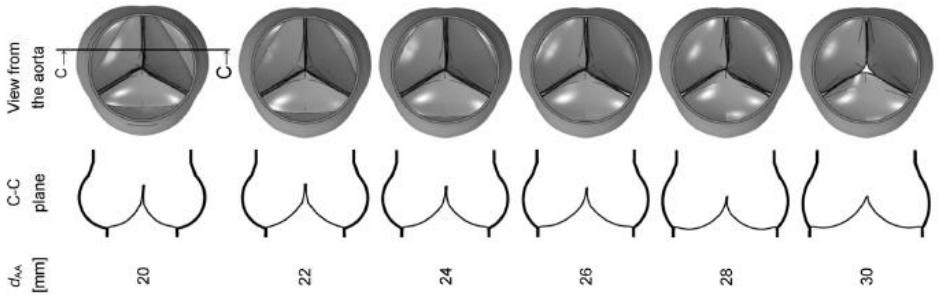


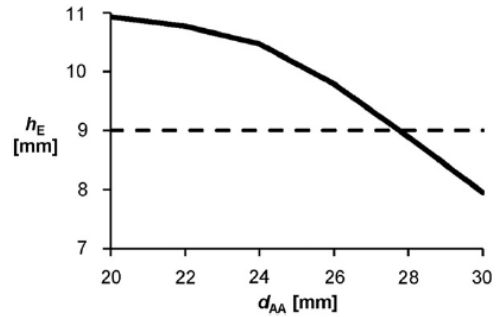
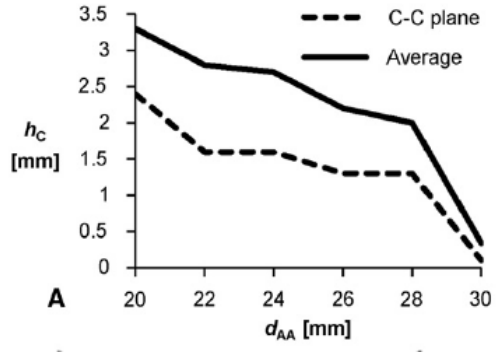




**FIGURE 2.** The effective height ($h_E$) as a function of annulus diameter ($d_{AA}$) under a pressure load of 3 mm Hg.

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# Remodeling root repair with an external aortic ring annuloplasty

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**TABLE 3. Influence of different parameters on late outcomes**

| Outcome | Freedom from AI ≥2 | | Freedom from AI ≥3 | | AV reintervention | | MAVRE | |
|---|---|---|---|---|---|---|---|---|
| Factor | HR, 95% CI | *P* value | HR, 95% CI | *P* value | HR, 95% CI | *P* value | HR, 95% CI | *P* value |
| Cusp effective height assessment | 0.96 (0.37-2.50) | .939 | -† | .043 | 0.13 (0.02-1.06) | .057 | 0.20 (0.05-0.76) | .018 |
| Cusp repair | 1.23 (0.47-3.25) | .676 | 0.46 (0.08-2.53) | .374 | 0.43 (0.10-1.84) | .257 | 0.52 (0.17-1.57) | .243 |
| Extra-Aortic ring (Extra-Aortic, CORONEO, Inc, Montreal, QC, Canada) | 1.5 (0.57-3.96) | .414 | -† | .026 | 0.11 (0.01-0.95) | .044 | 0.29 (0.09-0.98) | .046 |
| Leaflet anatomy | | .281 | † | .149 | | .151 | | .262 |
| Tricuspid | Reference | - | Reference | - | Reference | - | Reference | - |
| Bicuspid | 0.82 (0.26-2.57) | .737 | -† | | -† | | 0.18 (0.02-1.4) | .102 |
| Unicuspid | 3.07 (0.68-13.75) | .143 | 3.37 (0.39-28.9) | .267 | -† | | 0 | .983 |
| Preoperative AI* | 1.66 (1.1-2.51) | .016 | 1.63 (0.78-3.44) | .196 | 0.94 (0.53-1.65) | .824 | 0.98 (0.64-1.5) | .939 |
| Intraoperative Aortic annulus diameter | 1.02 (0.91-1.15) | .693 | 0.84 (0.51-1.38) | .493 | 0.88 (0.59-1.3) | .516 | 0.85 (0.62-1.16) | .303 |
| Valsalva diameter | 0.99 (0.94-1.05) | .853 | 1.00 (0.92-1.09) | .987 | 1.03 (0.98-1.09) | .268 | 1.02 (0.97-1.07) | .527 |
| STJ diameter | 1.03 (0.99-1.08) | .122 | 1.01 (0.93-1.1) | .778 | 1.01 (0.93-1.09) | .883 | 1.01 (0.95-1.07) | .676 |
| Preoperative LVEF | 0.97 (0.93-1.02) | .248 | 1.04 (0.93-1.16) | .462 | 1.04 (0.94-1.15) | .461 | 1.09 (1.00-1.18) | .042 |

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# Geometric ring annuloplasty as an adjunct to aortic valve repair: clinical investigation of the HAART 300 device

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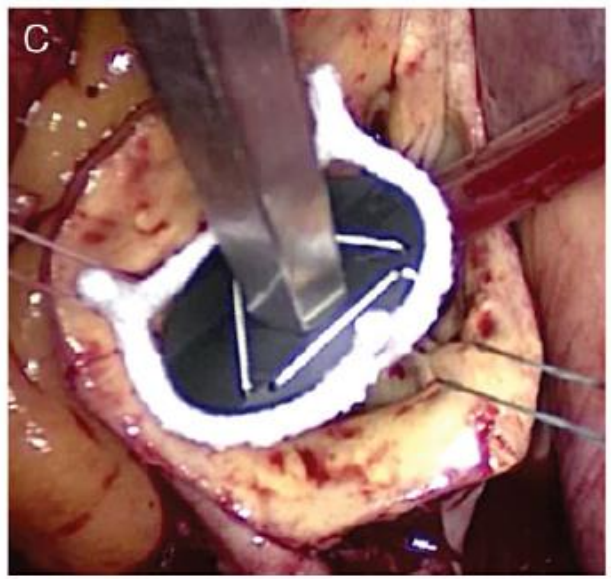


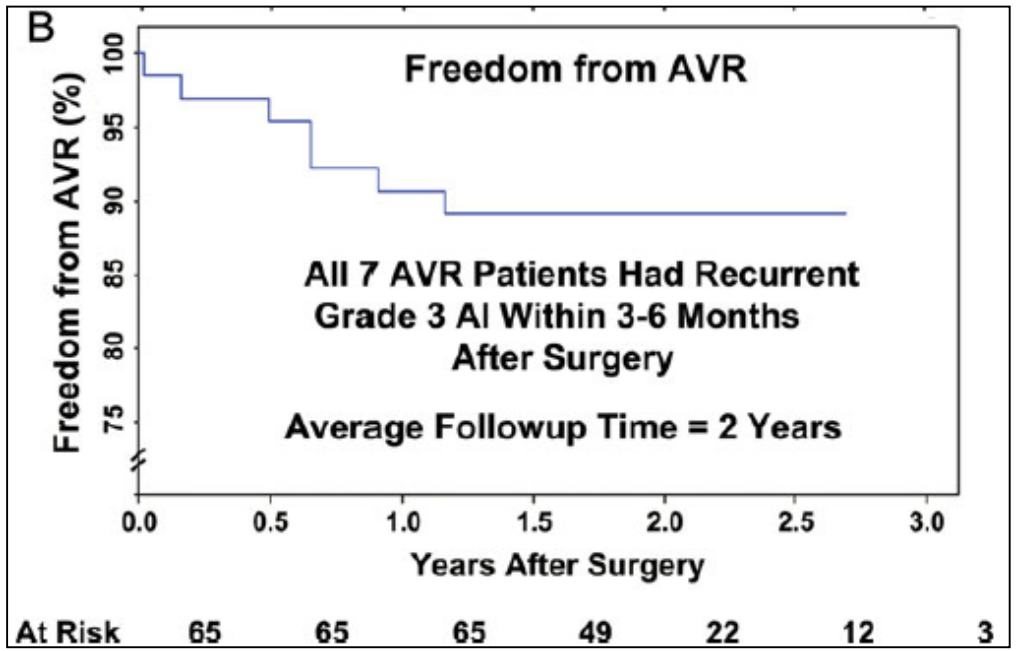

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**ORIGINAL ARTICLE**

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# The role of annular dimension and annuloplasty in tricuspid aortic valve repair†

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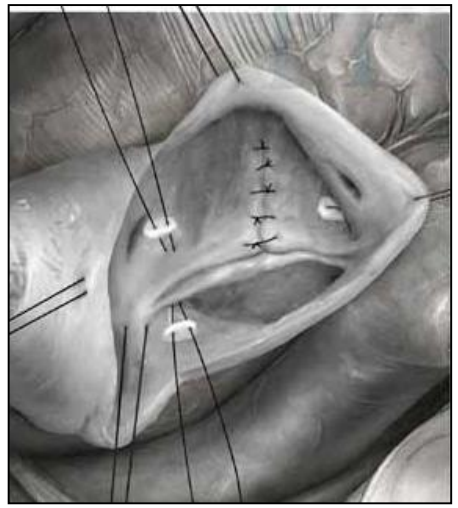
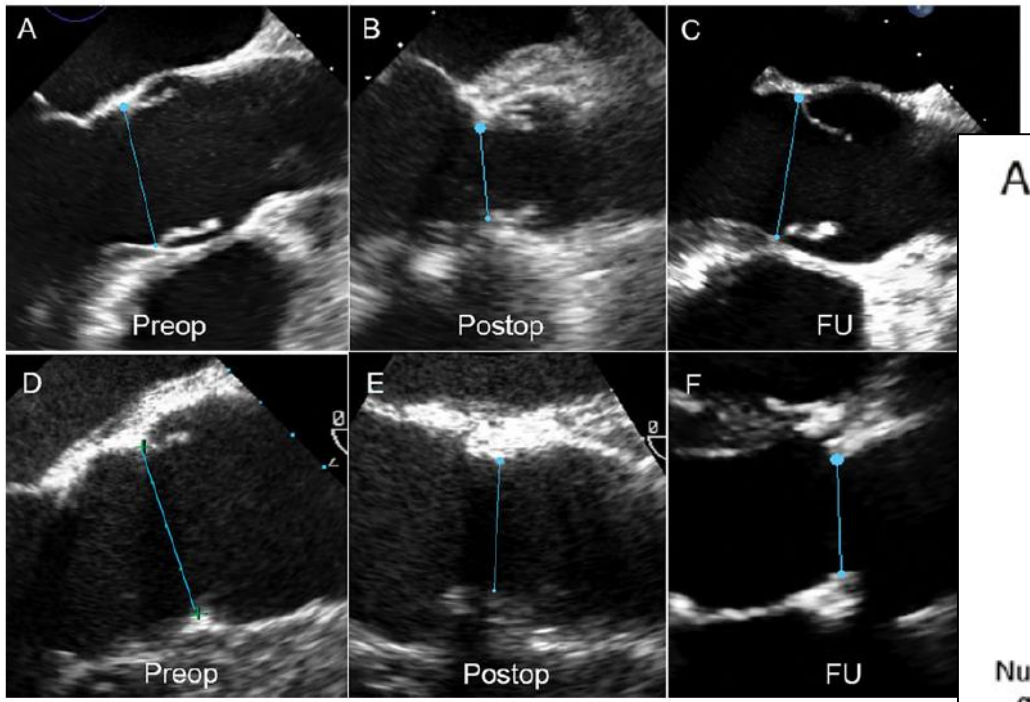
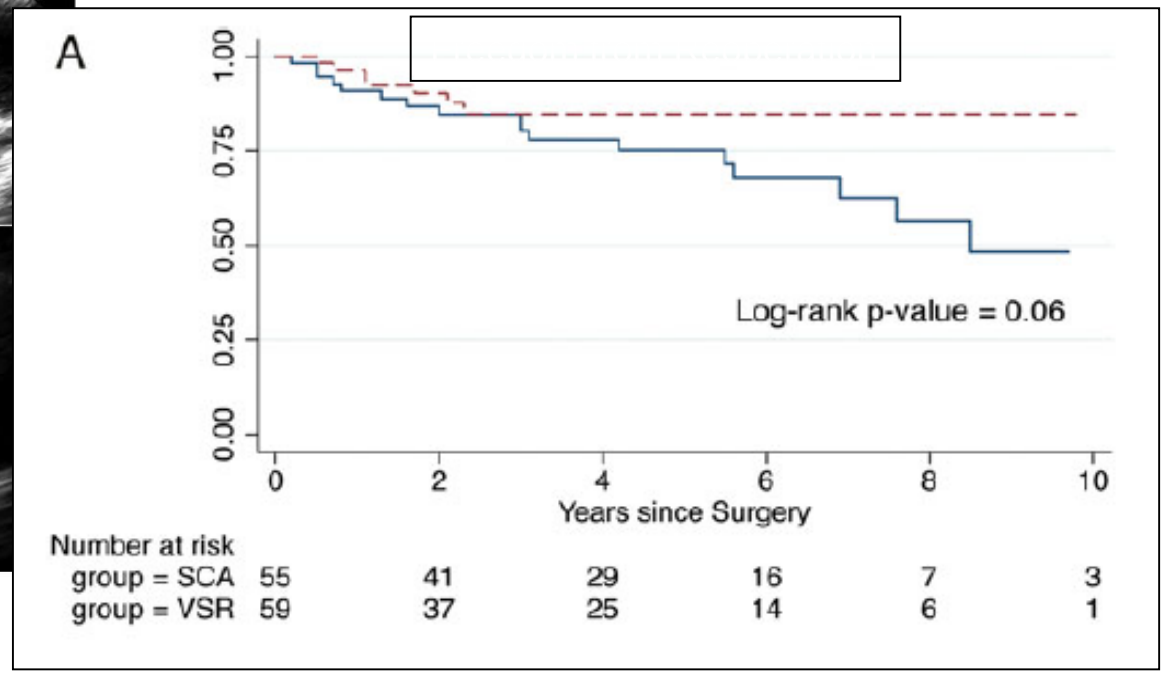
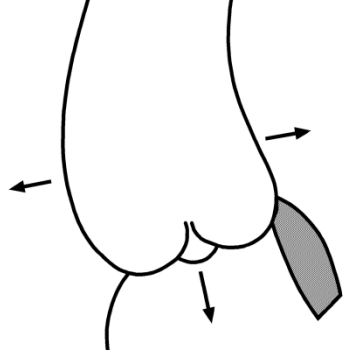






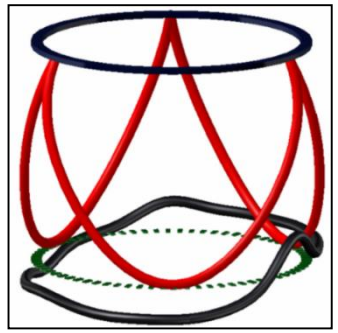
# Root Repair – Technical Options

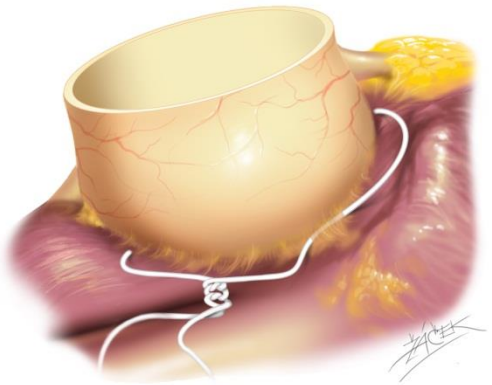
## Annular Stabilisation

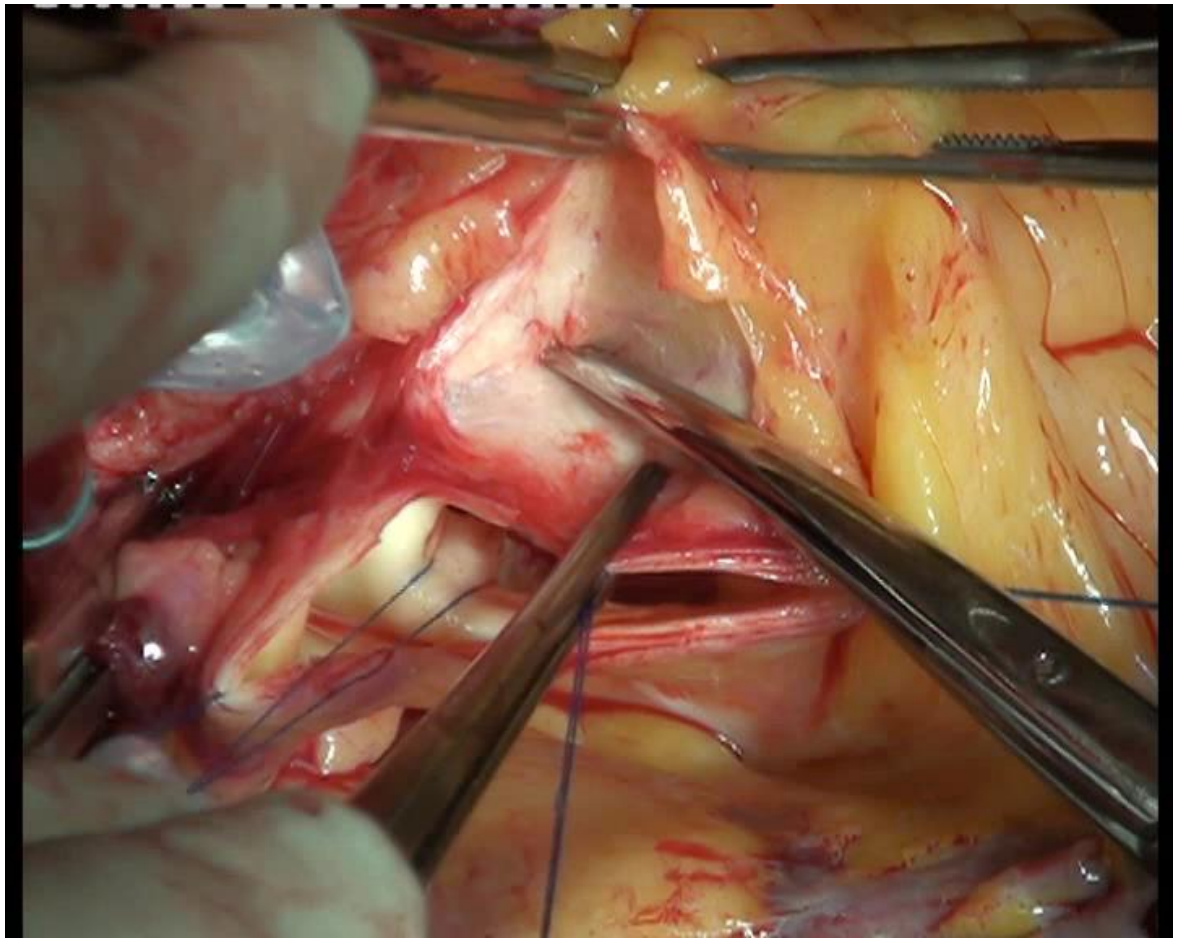
(> 27mm)

Subcommissural Plication

(Cabrol 1966)







# Suture Annuloplasty Significantly Improves the Durability of Bicuspid Aortic Valve Repair

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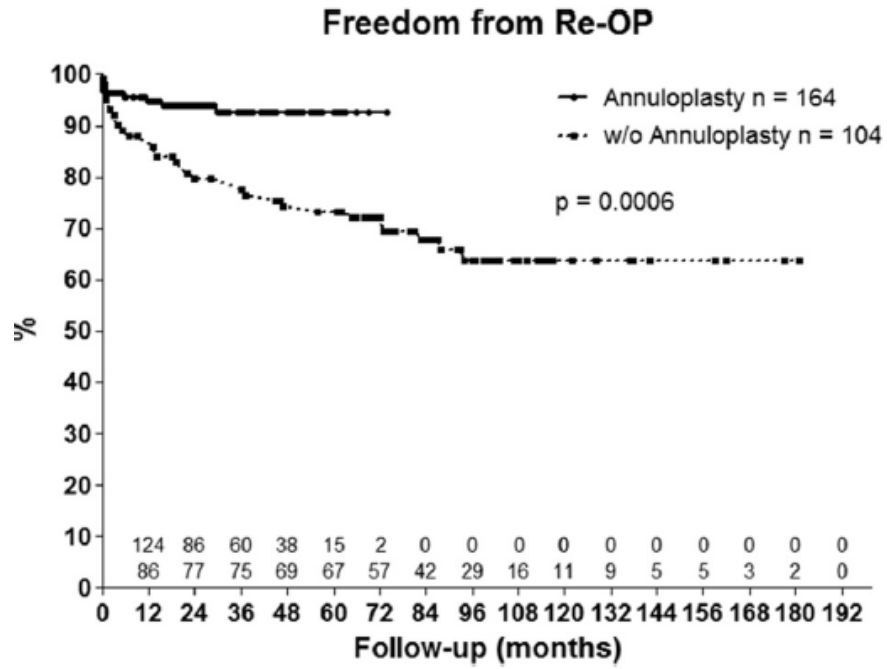
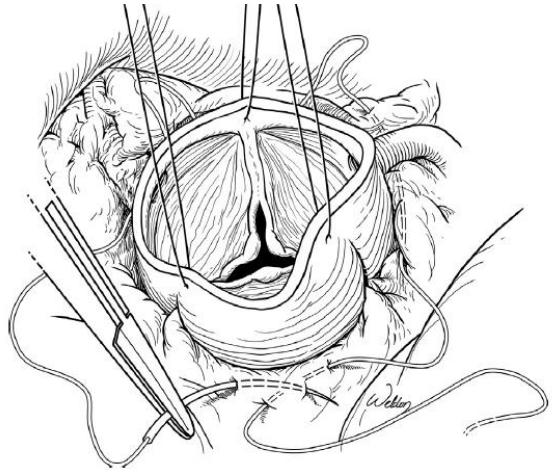


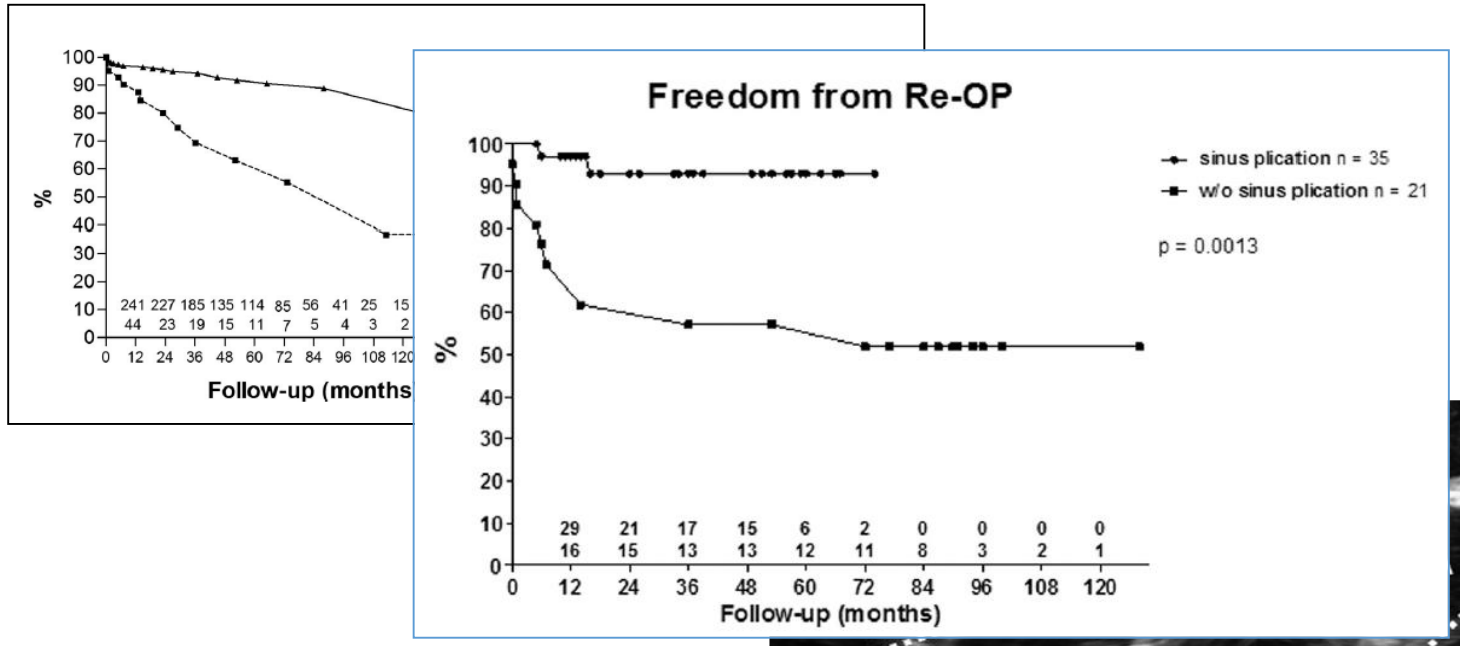

(Ann Thorac Surg 2017;103:504–10)



# Sinus Plication to Improve Valve Configuration in Bicuspid Aortic Valve Repair—Early Results

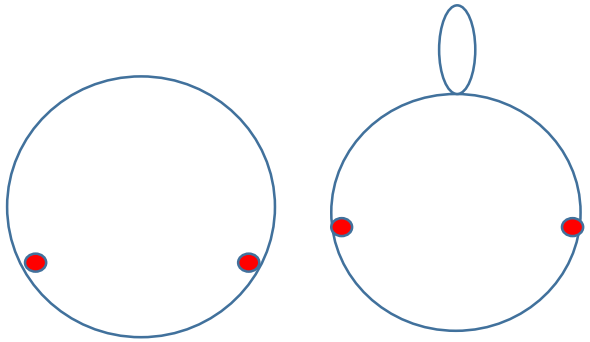
Ulrich Schneider, MD, Wolfram Schmied, Dipl-Psych, Diana Aicher, MD, Christian Giebels, MD, Lena Winter, MD, and Hans-Joachim Schäfers, MD

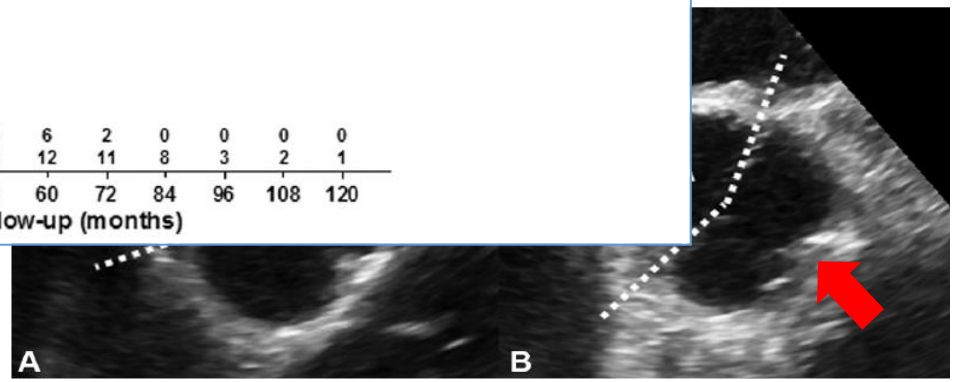
(Ann Thorac Surg 2017;103:580–6)












At discharge the mean peak transvalvular gradient in the study group was 14.3 ± 6.5 mm Hg, and it was 28.9 ± 18.5 mm Hg in the control group ($p = 0.003$).

# Valve Configuration Determines Long-Term Results After Repair of the Bicuspid Aortic Valve

Diana Aicher, MD; Takashi Kunihara, MD; Omar Abou Issa, MD; Brigitte Brittner, MD; Stefan Gräber, MD; Hans-Joachim Schäfers, MD

*Circulation* **January 18, 2011**

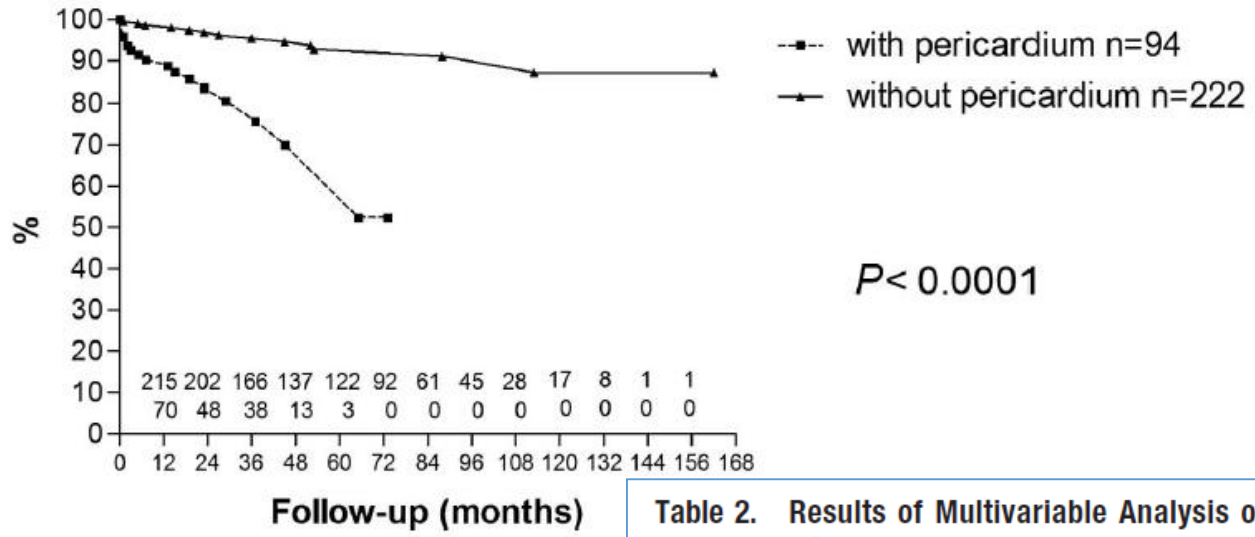



**Table 2. Results of Multivariable Analysis of Predictors for Reoperation**

| | HR | 95% Confidence Interval | *P* |
|---|---|---|---|
| Age | 0.955 | 0.928–0.982 | 0.001 |
| eH | 0.740 | 0.612–0.894 | 0.002 |
| AVD | 1.302 | 1.076–1.575 | 0.007 |
| Commissural orientation | 0.961 | 0.938–0.985 | 0.002 |
| Pericardial patch | 5.175 | 2.100–12.753 | 0.000 |
| Subcommissural plication | 0.699 | 0.299–1.633 | 0.408 |
| Root repair | 2.354 | 0.770–7.192 | 0.133 |

# Aortic Valve Reconstruction

- AV reconstruction is on its way to a rational and reproducible procedure based on geometric principles (A + B + C + ? = functioning AV)
- Scientific basis is becoming clearer
- Valve-related complications are rare if repair is stable
- Durability of repair is better than that of bioprostheses in young patients
- The need for patch repair of cusps is associated with limited durability
- AV reconstruction should be considered in every patient with AR




Thank you for your attention