

Root Remodeling is my Standard Approach

H.-J. Schäfers
Dept. of Thoracic and Cardiovascular Surgery
Saarland University Medical Center



Disclaimer: I did not invent this operation!

Remodeling of the aortic valve annulus

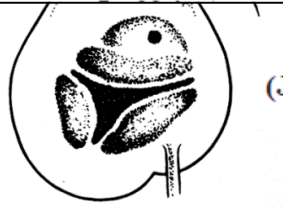
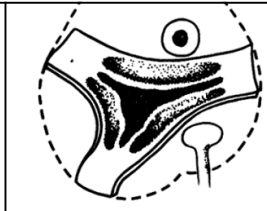
Isolated aortic valve regurgitation that results from disease that primarily affects the aortic wall can be repaired by remodeling of the aortic annulus to restore its normal geometry. This involves excision of the aortic wall to within 2 to 3 mm of the leaflet attachments, detachment of the

coronary ostia, of the coronary are often present erience with 10 National Heart IDIOVASC SURG

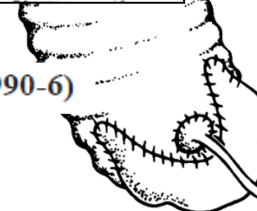
VALVE-PRESERVING REPLACEMENT OF THE ASCENDING AORTA: REMODELING VERSUS REIMPLANTATION

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 for proximal aortic disease between October 1995 and November 1997, 40 patients had morphologically intact aortic valve leaflets in conjunction with dilatation of the aortic root. Of these, 15 patients underwent an operation as a surgical emergency for acute aortic dissection type A.



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



A handwritten signature in black ink, located in the bottom right corner of the page.

Valve-sparing surgery: Long-term results

David JTCVS 2006

	Freedom from AR > II (10 years)	Freedom from reoperation (10 years)
Reimplantation (n=167)	94%	96%
Remodeling (n=53)	75%	93%

Yacoub JTCVS 1998

	Freedom from AR \geq II (10 years)	Freedom from reoperation (10 years)
Remodeling (n=158)	64%	89%



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.

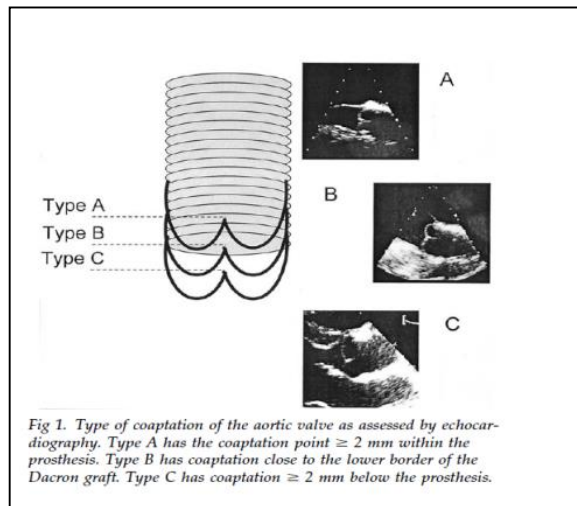
Results. No mortality was observed within the first 30 days. There were 52 male patients, mean age was 49.1 ± 20.6 years, observation period was 35.6 ± 20.6 months, and Marfan's syndrome was present in 22 patients. Although in 67 patients a stable valve function could be

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)

© 2002 by The Society of Thoracic Surgeons



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 replace-

ment 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)

© 2007 by The Society of Thoracic Surgeons

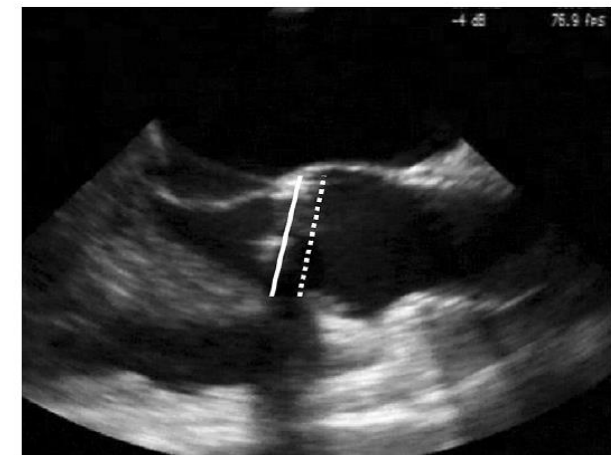
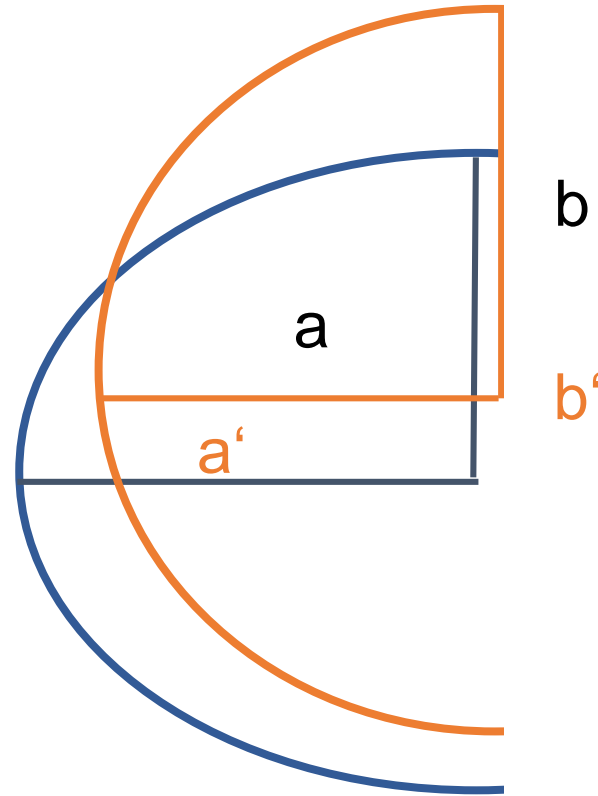


Fig 5. Typical echocardiogram of a patient with symmetric prolapse after separate valve repair and aortic replacement. The dotted line marks the coaptation level of the free margins, the solid line, the level of the aortic insertion. The most striking finding is an abnormally low height difference of 4 mm between central cusps and aortic insertion.

Reduction of STJ and Cusp Prolapse



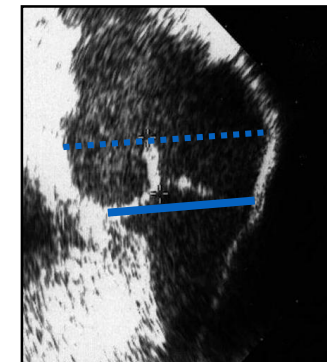
$$C_E = \pi \times [3/2 \times (a+b) - \sqrt{a \times b}]$$

$$b \approx r_{\text{aorta}}$$

$$a \approx r_{\text{cusp}}$$

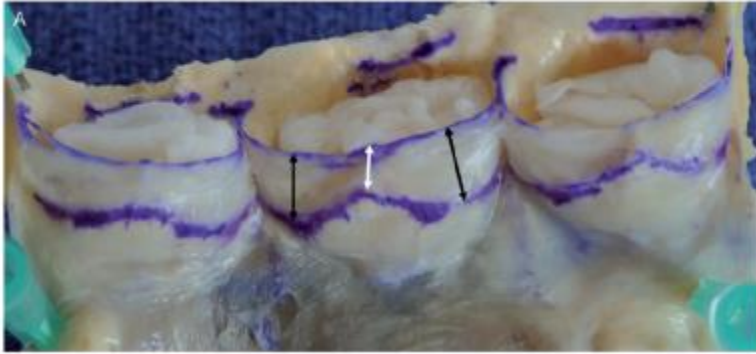


$$r_{\text{cusp}} \approx 1 / r_{\text{aorta}}$$



How high is high enough?

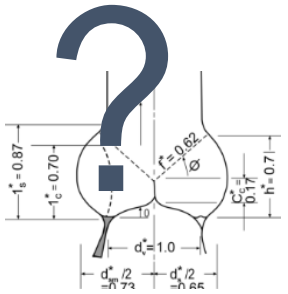
✓ Coaptation height should be high for secure diastolic function.



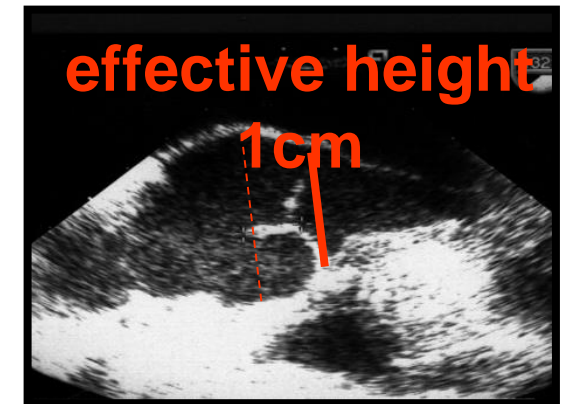
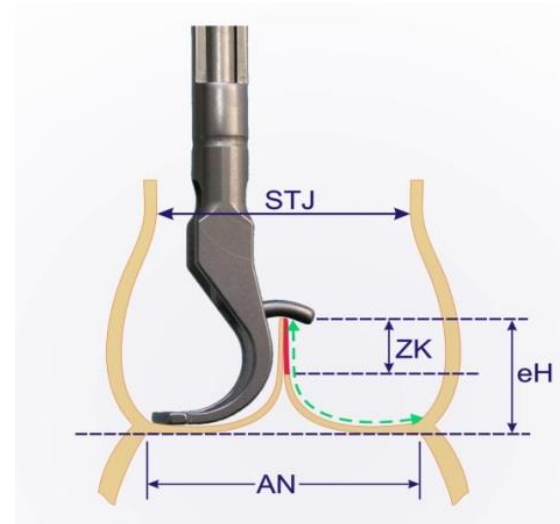
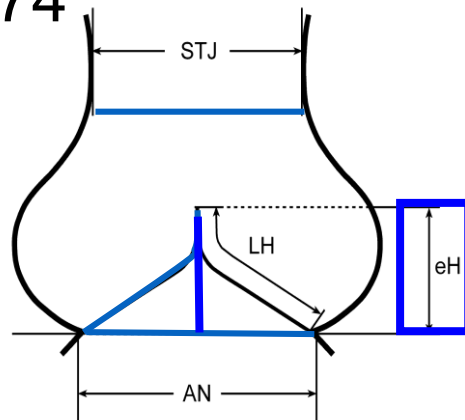
* These images are not meant to bias for or against any religion



Aortic Valve Repair - Assessment Configuration/coaptation of cusps

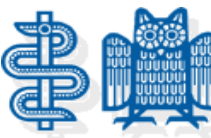


Swanson, Circ Res 1974



A new approach to the assessment of aortic cusp geometry

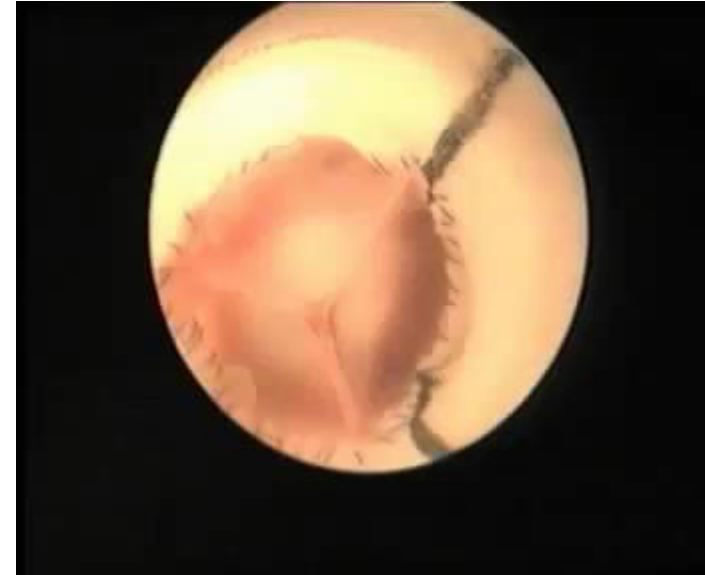
Hans-Joachim Schäfers, MD, PhD, Benjamin Bierbach, MD, and Diana Aicher, MD, Homburg/Saar, Germany



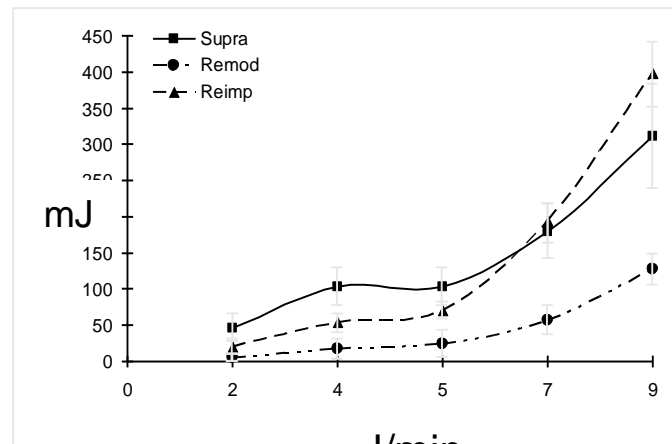
Reimplantation



Remodeling



Systolic Energy Loss



2 l/min

Valve-Sparing Surgery

Cusp Changes after Reimplantation

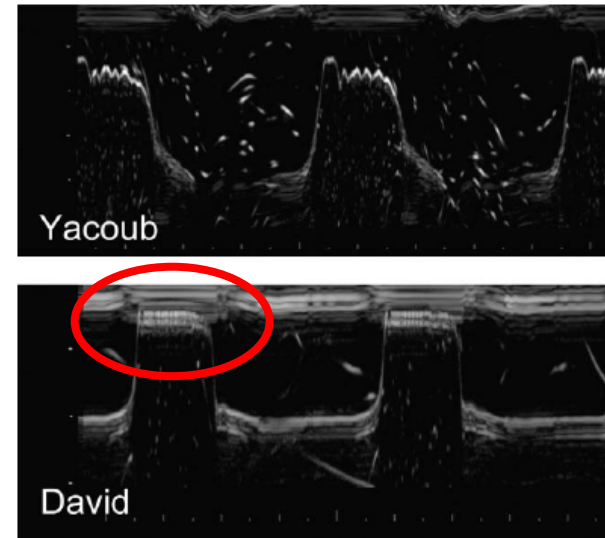
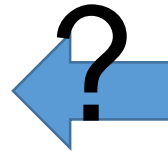
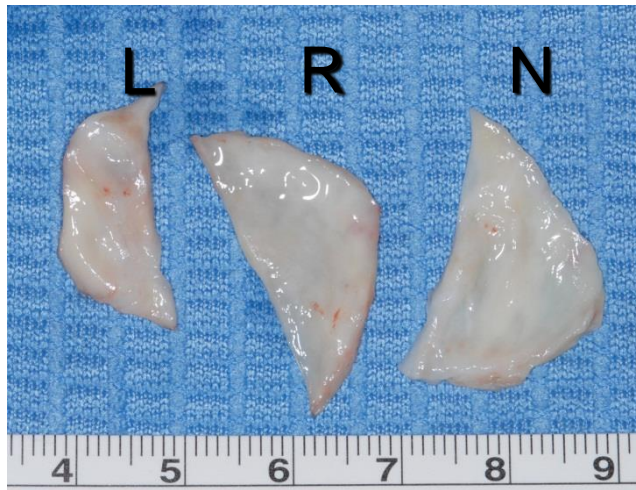


Figure 3. Typical M-mode recording of aortic valve motion after reimplantation (*David*) and remodeling (*Yacoub*).

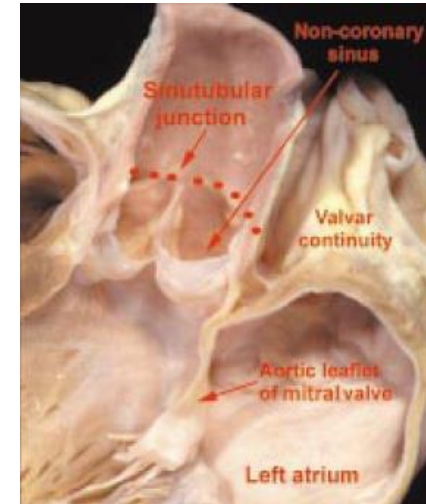
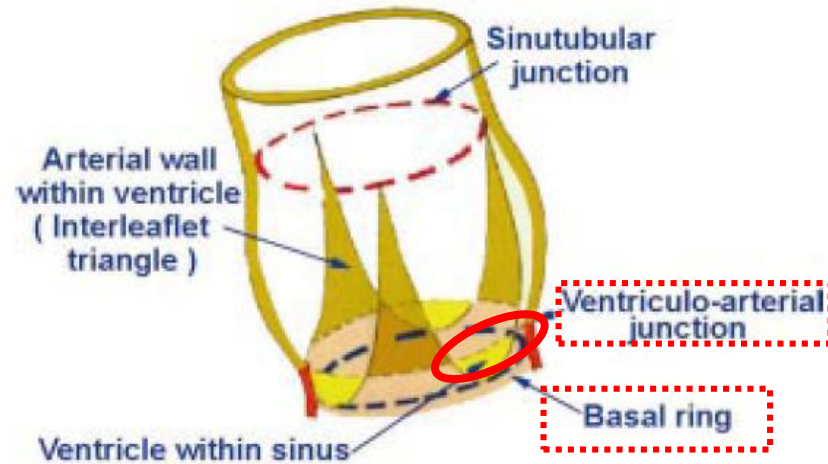
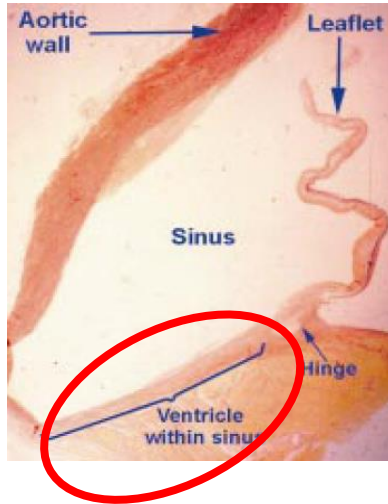
In vitro comparison of aortic valve movement after valve-preserving aortic replacement

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

41 yo Marfan Patient 22 yrs p Reimplantation



Aortic Sinus Anatomy



Crescents of LV muscle at base of (left and) right sinus (variable)



	Remodeling (N=494)	Reimplantation (N=29)
Age (yrs)	58 ± 15	42 ± 16
Sex (m/f)	372 / 122	20 / 9
Tricuspid AV	333	27
BAV/UAV	154/7	2/-
Diagnosis: Aneurysm	428	23
AADA	59	6
CADA	7	-
Marfan	13	12



	Remodeling (N=494)	Reimplantation (N=29)
Concomitant procedures		
CABG	89*	1
MVR	16	1
part. arch	131*	8
tot. arch	26	2
Myoc. Ischemia (min)	82 ± 20*	112 ± 24

* p<0.05

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

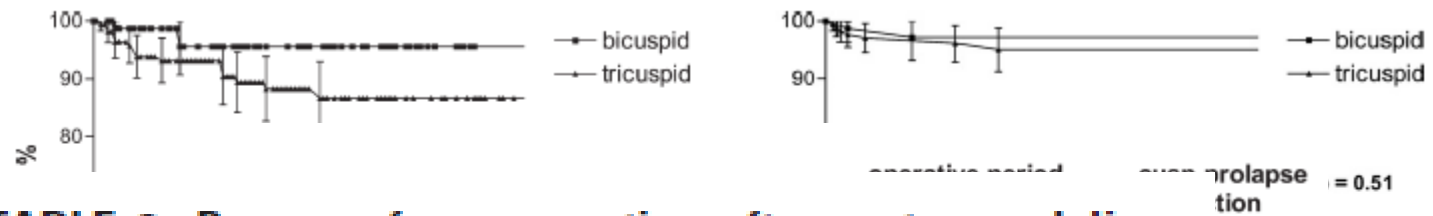


TABLE 3. Reasons for reoperation after root remodeling, stratified for aortic valve anatomy

Reasons for reoperation	BAV	TAV
Symmetric cusp prolapse	2	4
Dilatation at the aortoventricular level	0	1
Endocarditis	0	1
Secondary cusp retraction	0	1

BAV, Bicuspid aortic valve; TAV, Tricuspid aortic valve.

ents after
anatomy
intervals



Preoperative aortic root geometry and postoperative cusp

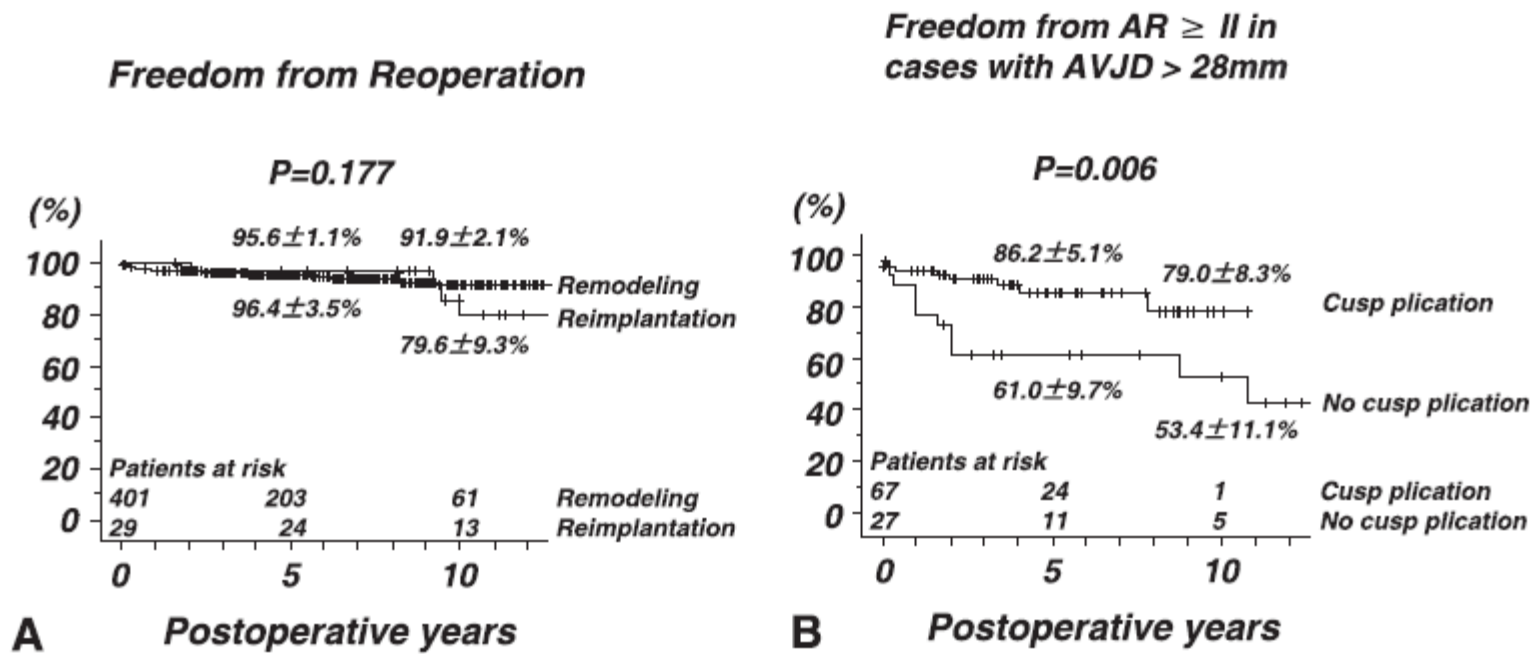
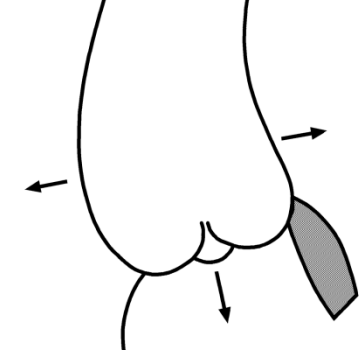


FIGURE 3. A and B, Freedom from reoperation of patients who underwent remodeling (*thin line*) or reimplantation (*bold line*).

Handwritten signature or mark.

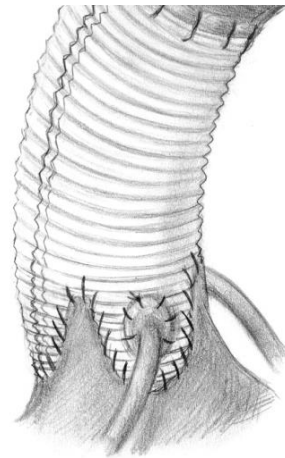
Root Repair – Technical Options



Subcommissural
Plication

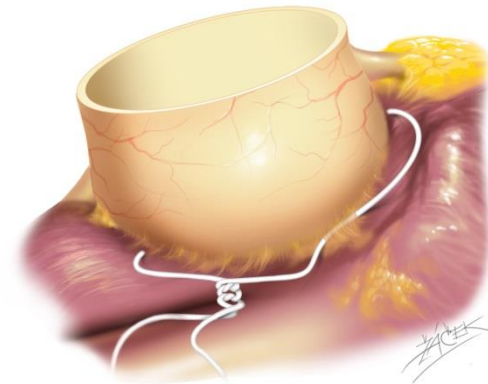


(Cabrol 1966)

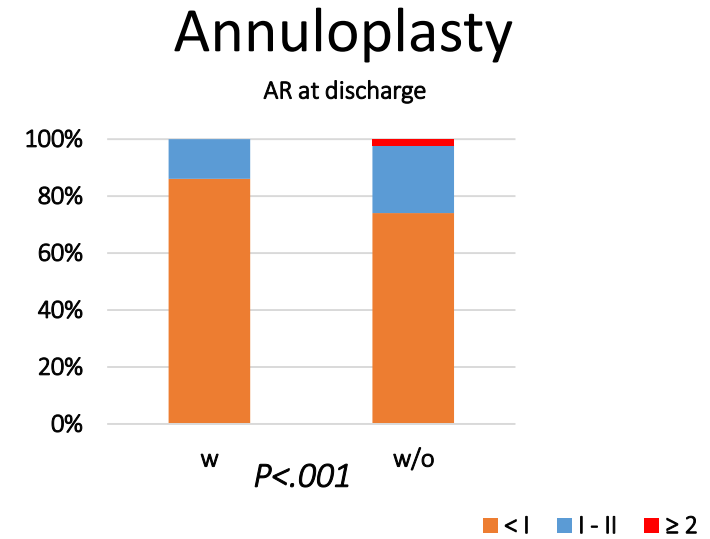
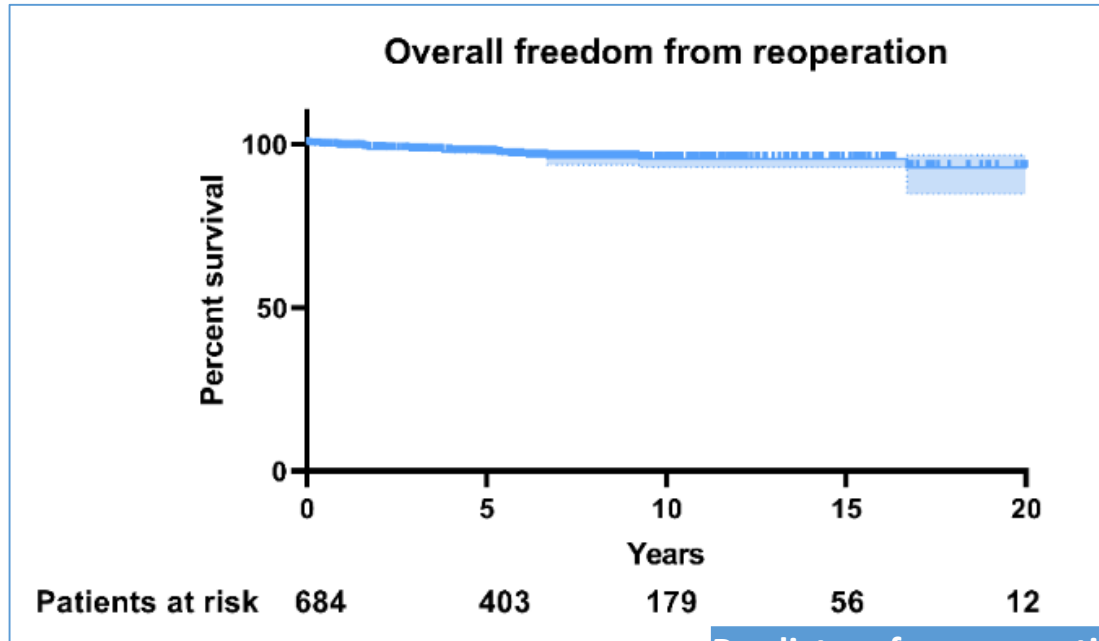


Suture Annuloplasty
(AVJ > 27mm)

+



Results: Freedom from Reoperation



Predictors for reoperation	P	OR	95% CI
No eH measurement	0.005	3.441	1.451-8.159
Age	0.833		
Annuloplasty	0.145		
Repair of 3 cusps	0.444		
Preoperativ AR III	0.536		
Connective disorder	0.555		

Aortic annulus does not dilate over time after aortic root remodeling with or without annuloplasty



Takashi Kuniyara, MD, PhD,^a Satoshi Arimura, MD,^a Fumihiko Sata, MD, PhD,^b Christian Giebels, MD,^c Ulrich Schneider, MD,^c and Hans-Joachim Schäfers, MD, PhD^c

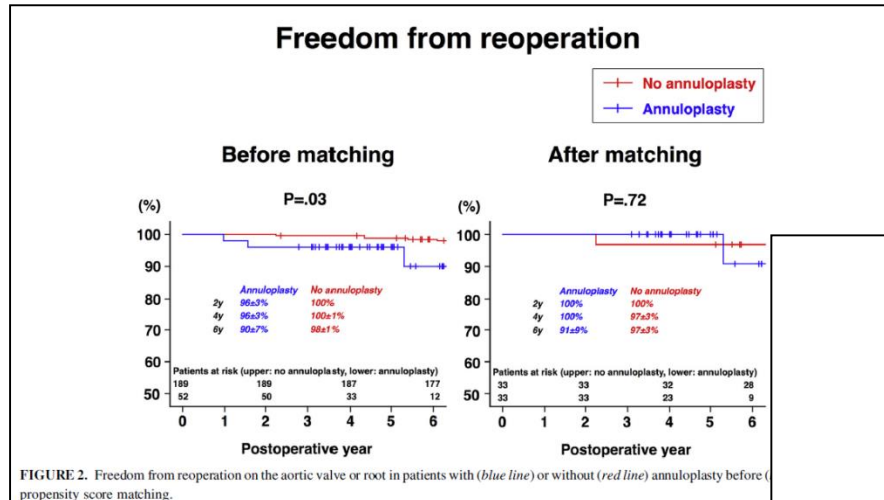


FIGURE 2. Freedom from reoperation on the aortic valve or root in patients with (blue line) or without (red line) annuloplasty before (left) and after (right) propensity score matching.

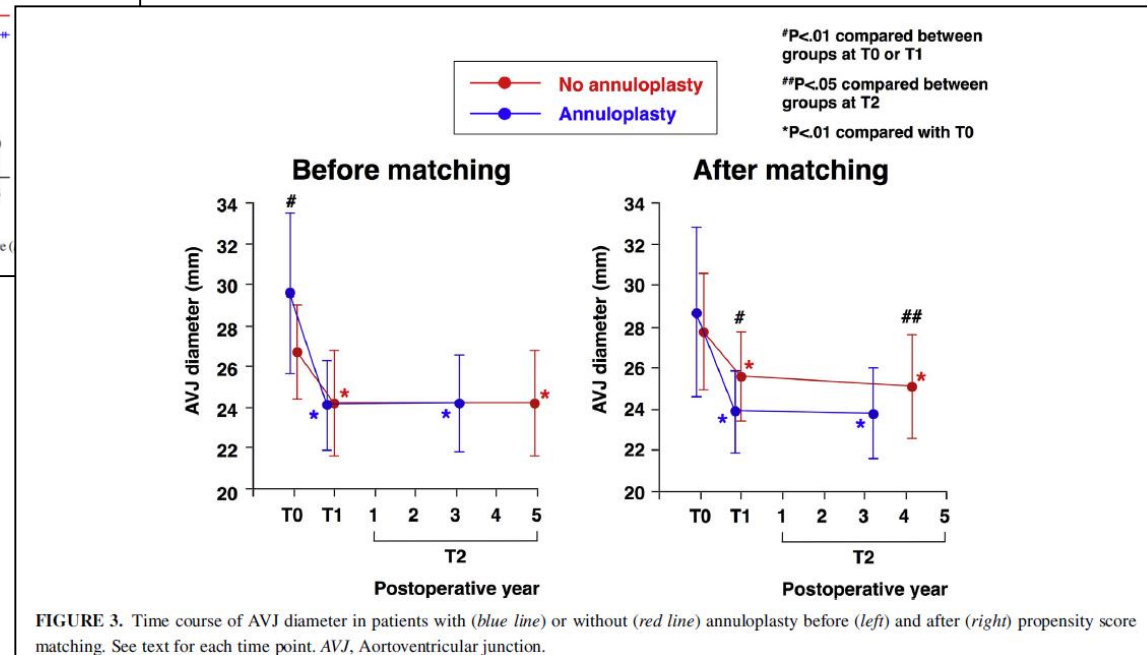


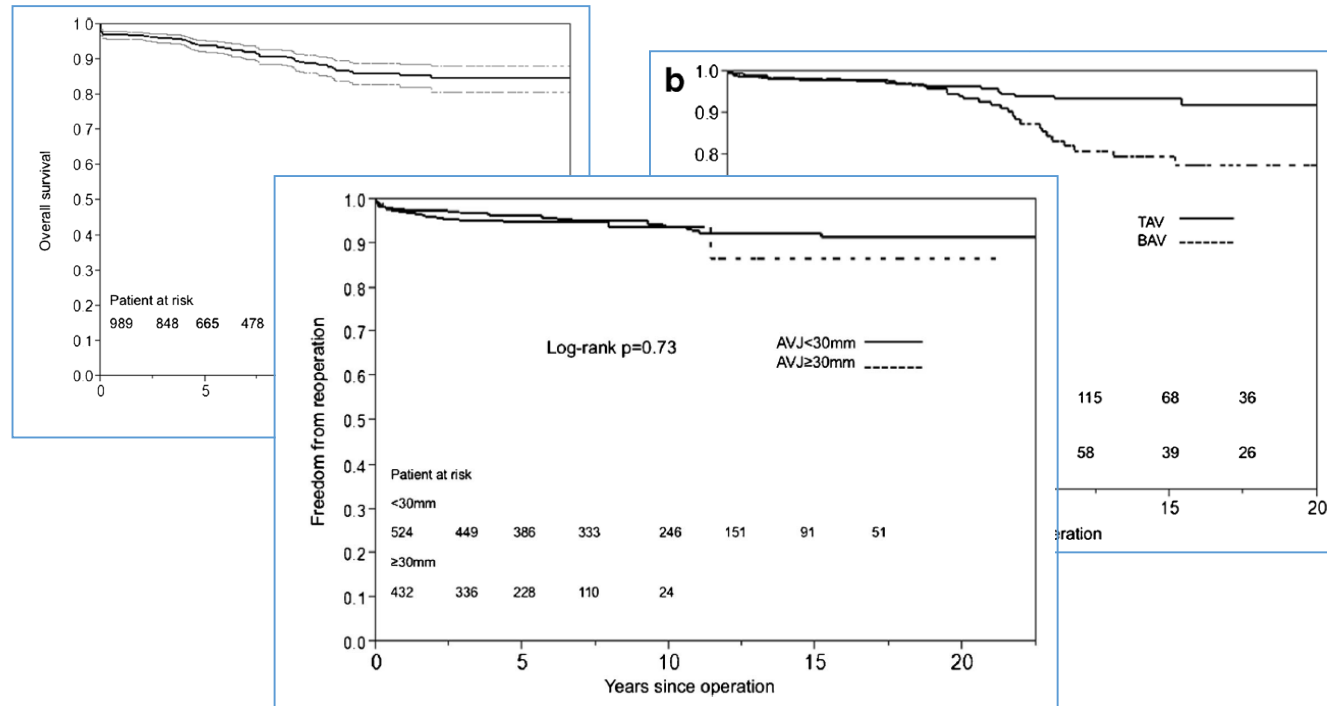
FIGURE 3. Time course of AVJ diameter in patients with (blue line) or without (red line) annuloplasty before (left) and after (right) propensity score matching. See text for each time point. AVJ, Aortoventricular junction.



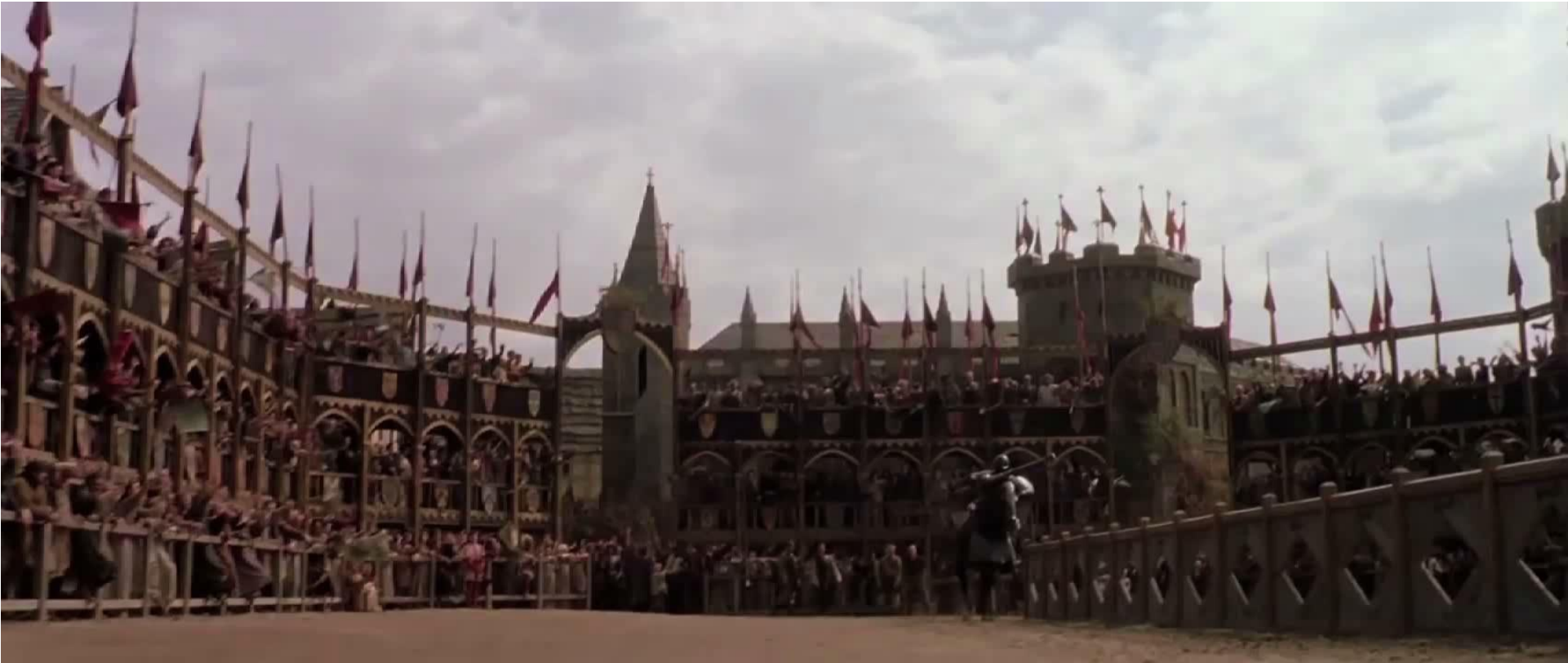


Aortic root remodeling in bicuspid and tricuspid aortic valves—long-term results

Shunsuke Miyahara¹ · Irem Karliova¹ · Christian Giebels¹ · Ulrich Schneider¹ · Shunsuke Matsushima¹ · Hans-Joachim Schäfers¹



The fully protected aortic valve?



Current Readings: Aortic Valve–Sparing Operations

Tirone E. David, MD^{*,†}

Semin Thoracic Surg 26:231–238 © 2014

aortic aneurysms and normal aortic annulus. Thus, both techniques are useful in preserving the aortic valve. With either technique, restoration of normal aortic annulus and cusp geometry is the single most important technical aspect of these operations. In addition to having a competent valve with no

this maneuver can correct the problem. Thus, selection of the size of the graft is a complex problem in aortic valve reimplantation. We have stated

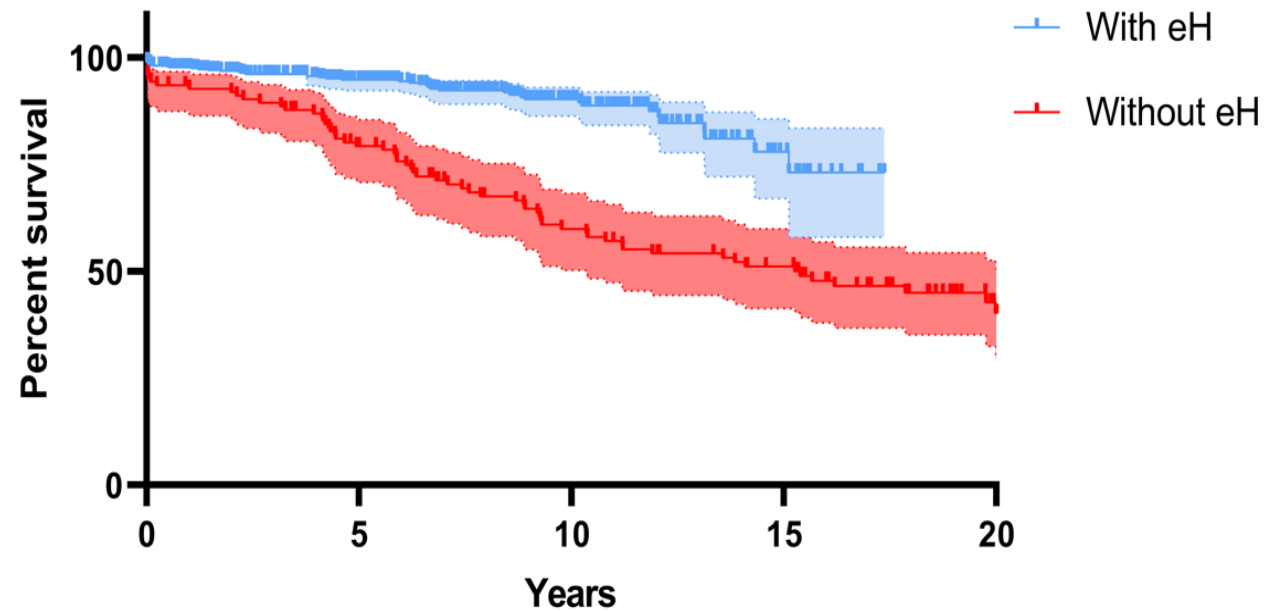
in aortic valve reimplantation. We have stated numerous times that reimplantation of the aortic valve is a far more complex operation than remodel-

root aneurysm associated with ascending aortic aneurysm and normal aortic annulus very well after the remodeling procedure, technically less demanding than the aortic valve. Younger patients

ing of the aortic root because it alters the geometry of postoperatively.¹⁵ Finally, aortic valve–sparing operations are an alternative to composite replacement of the aortic valve and ascending aorta, and as there is no evidence of their superiority, the surgeon “has to have an open and receptive mind but a balanced view” of these operations and give the patient what is best in his or her hands.

Root Remodeling

Survival with or without eH measurement $p < .0001$



Patients at risk

280

130

41

139

66

26





Conclusions

Root remodeling
reimplantation

RR can be applied

RR leads to near

RR may lead to
detected and
durability!

Addition of an
(durability?)

RR is my preferred form or valve-preserving root replacement, (at least for all patients without connective tissue disease).



more than valve

anatomy)

graft), but this can be
ion determines

competent valves