Reconstruction of the Aortic Valve and Root: A Practical Approach
September 14th-16th , Homburg/Saar, Germany

Reimplantation Should Be Preferred

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Cliniques universitaires SAINT-LUC UCL BRUXELLES

UCL Université catholique de Louvain

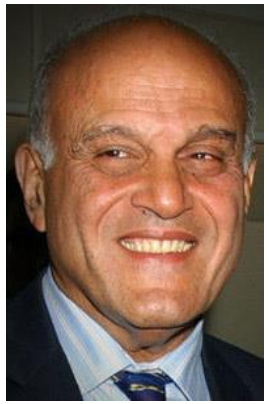
Reimplantation vs Remodeling

Day 2

07.45	Case presentations	
	Live operations: Moderation M. De Bonis	
08.00	Case #1	
09.30	Case #2	
	BREAK	
11.00	Failures after aortic valve repair	*D. Aicher*
11.30	Case #3	
12.45	Discussion of the cases	
	BREAK	
13.00	Reimplantation should be preferred	*L. de Kerchove*
13.15	Remodeling should be the standard	*H.-J. Schäfers*
14.00	3-dimensional echo in aortic valve repair	*A. Hagendorff*
14.30	How to start root repair	*H.-J. Schäfers*
	BREAK	
15.30	Wetlab (bring your loupes!)	*Faculty*
18.00	Adjourn	

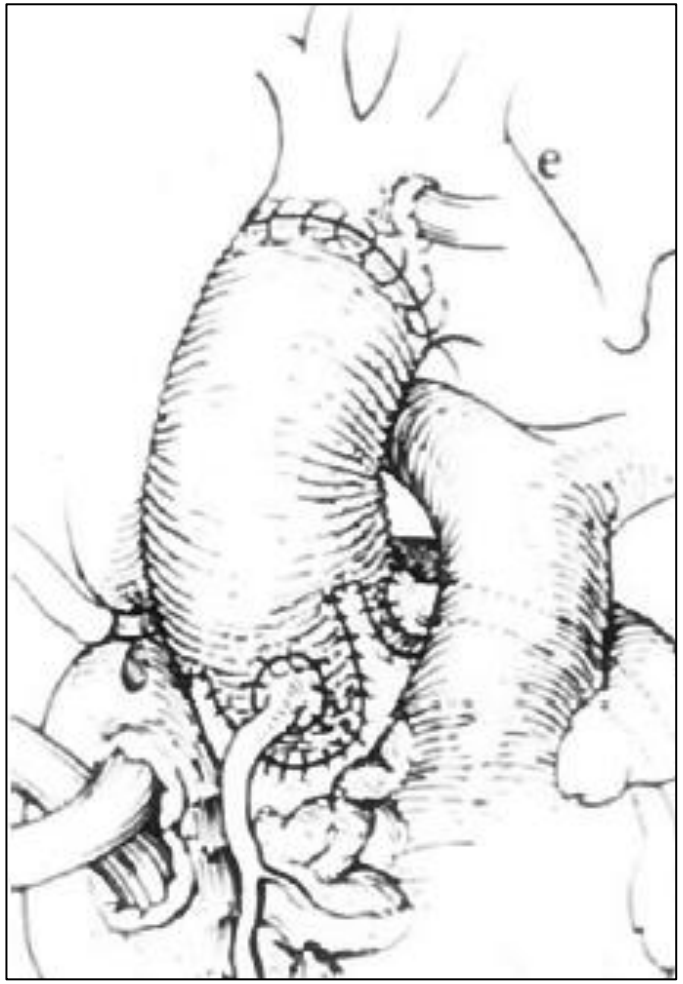
!!?

VSRR: The Origin

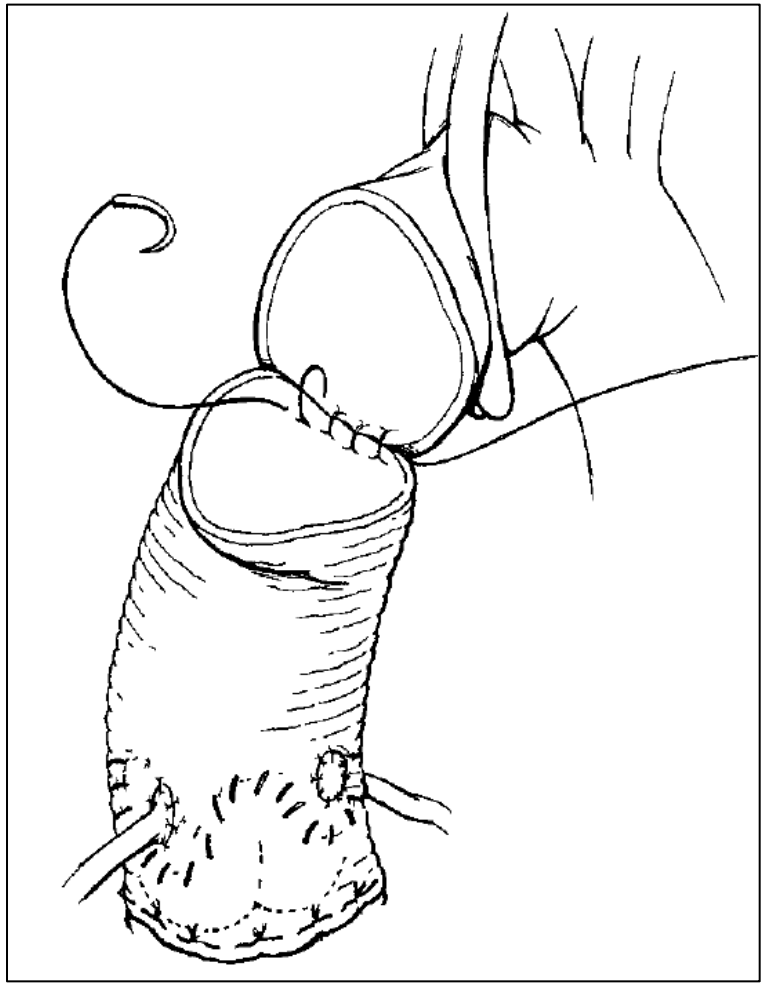


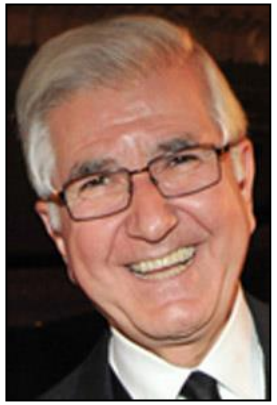
Sir M. Yacoub

Remodeling technique (1983)



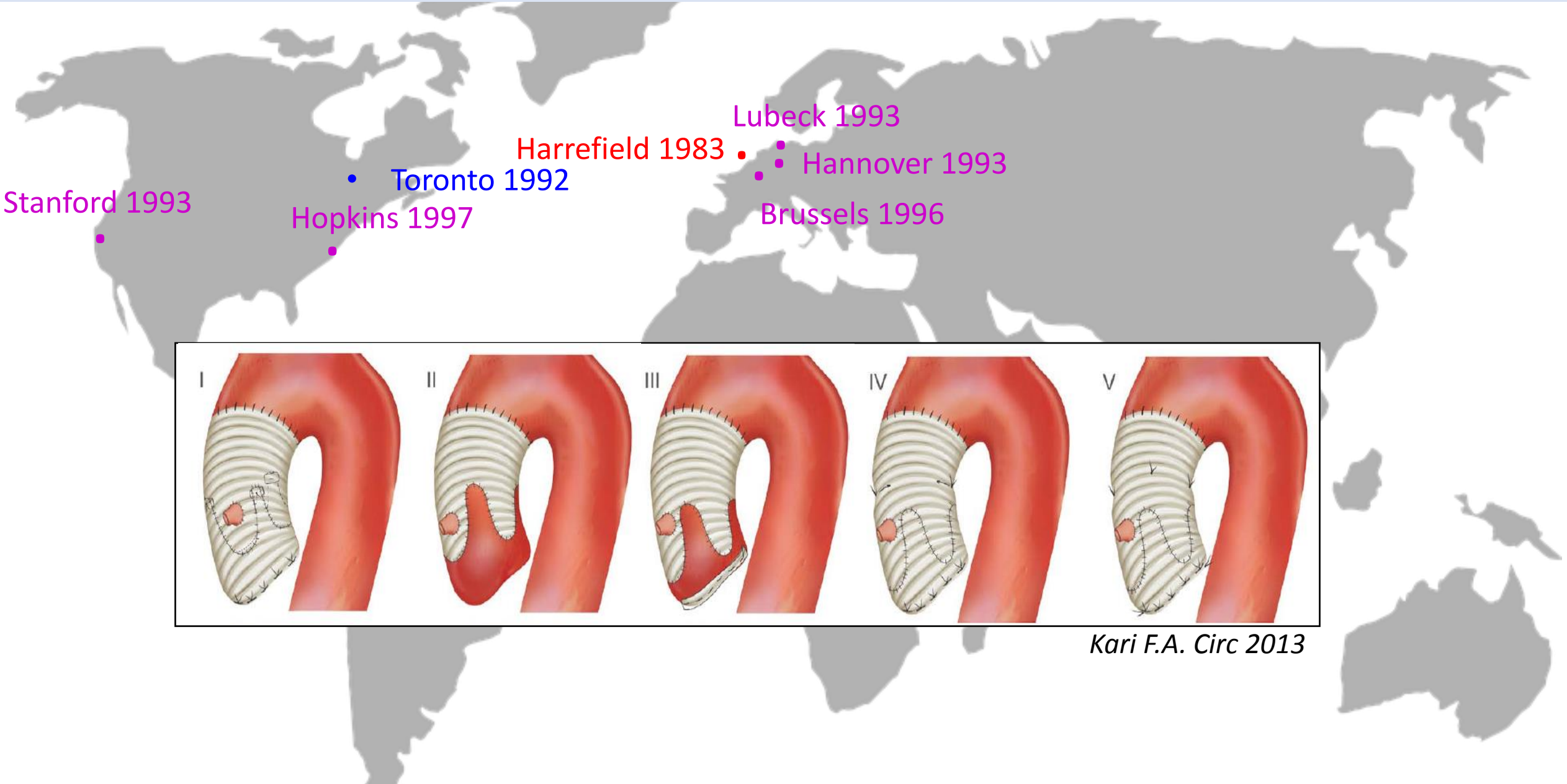
Reimplantation technique (1992)





T. David

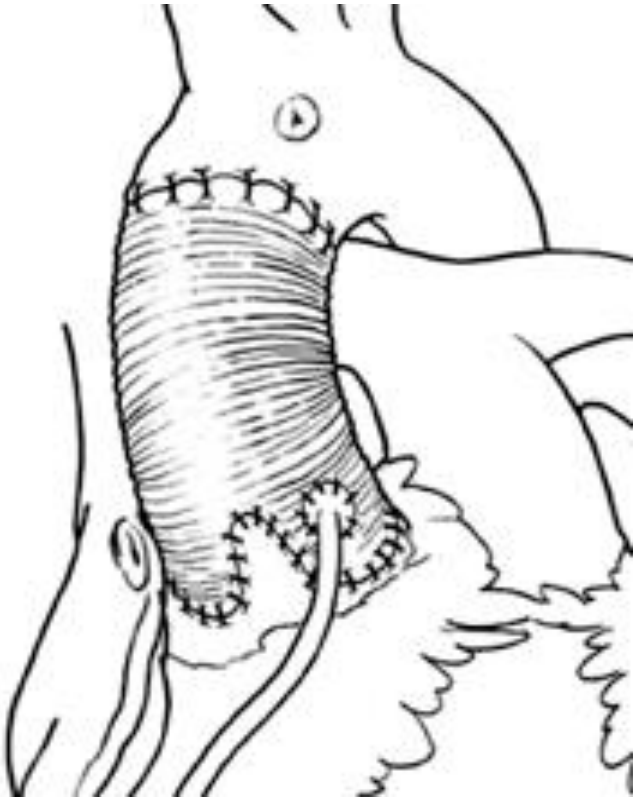
VSRR: Initial enthusiasm for both techniques (Reimpl – Remod)



Kari F.A. Circ 2013

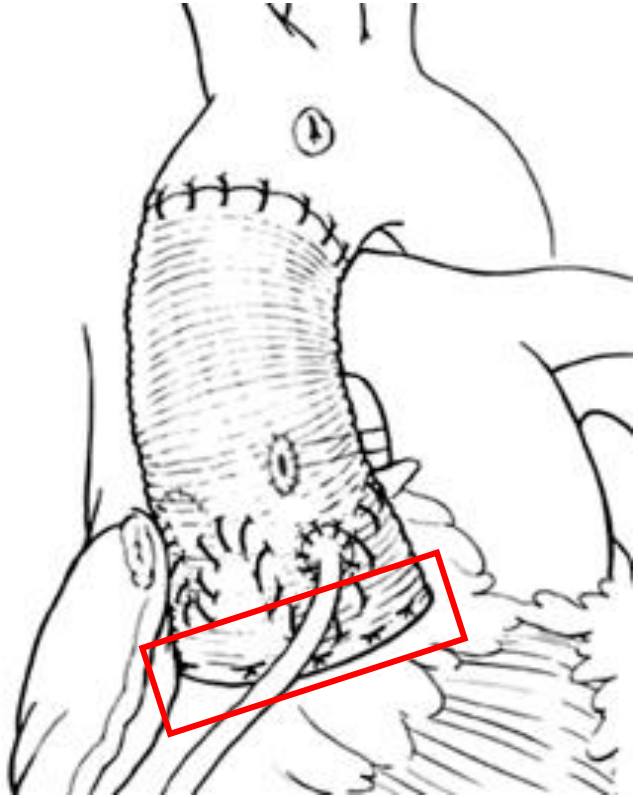
VSRR: Doubt on Remodeling ?

Remodeling



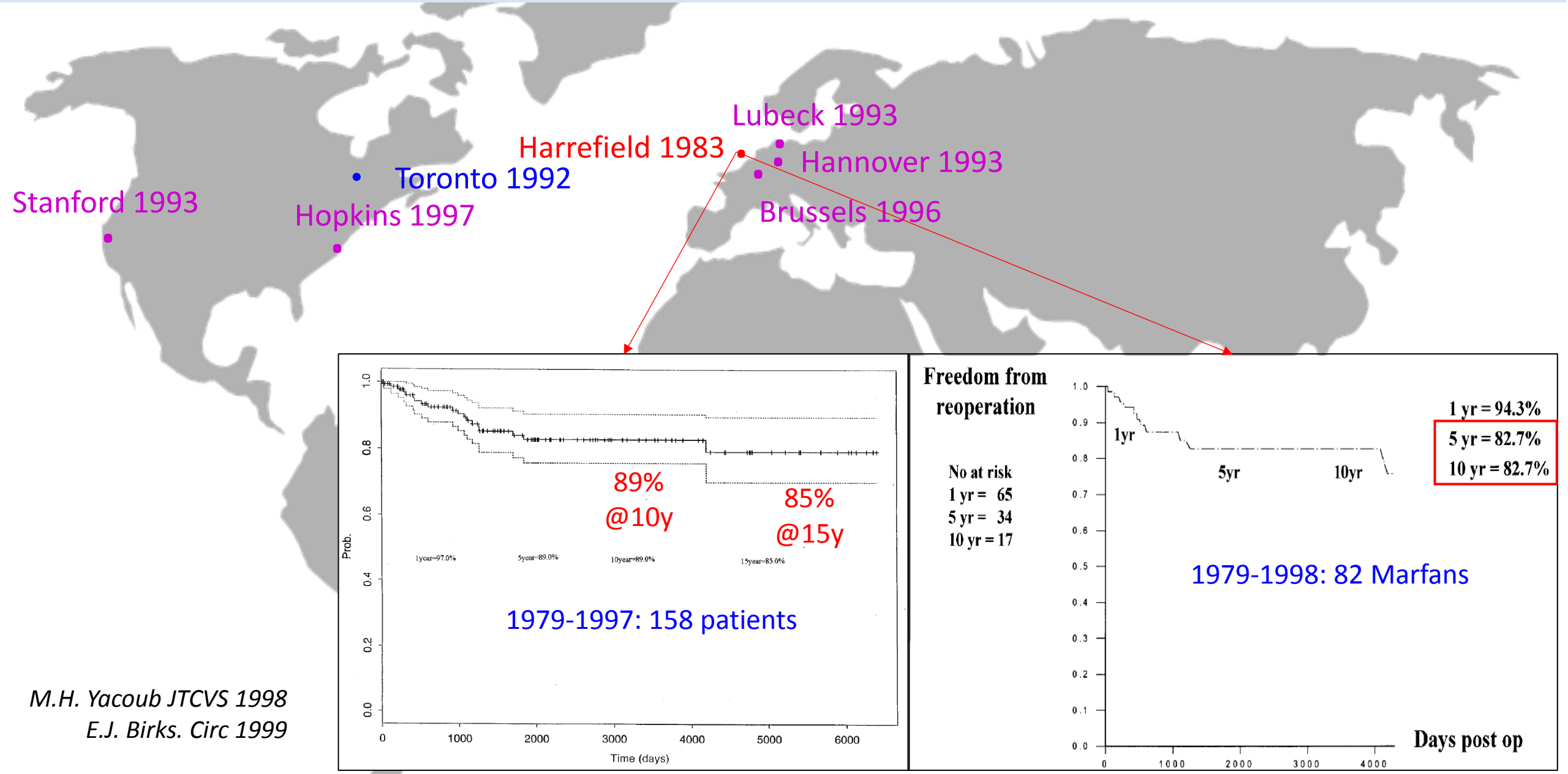
- Faster
- Less root dissection
- Only 1 suture line

Reimplantation



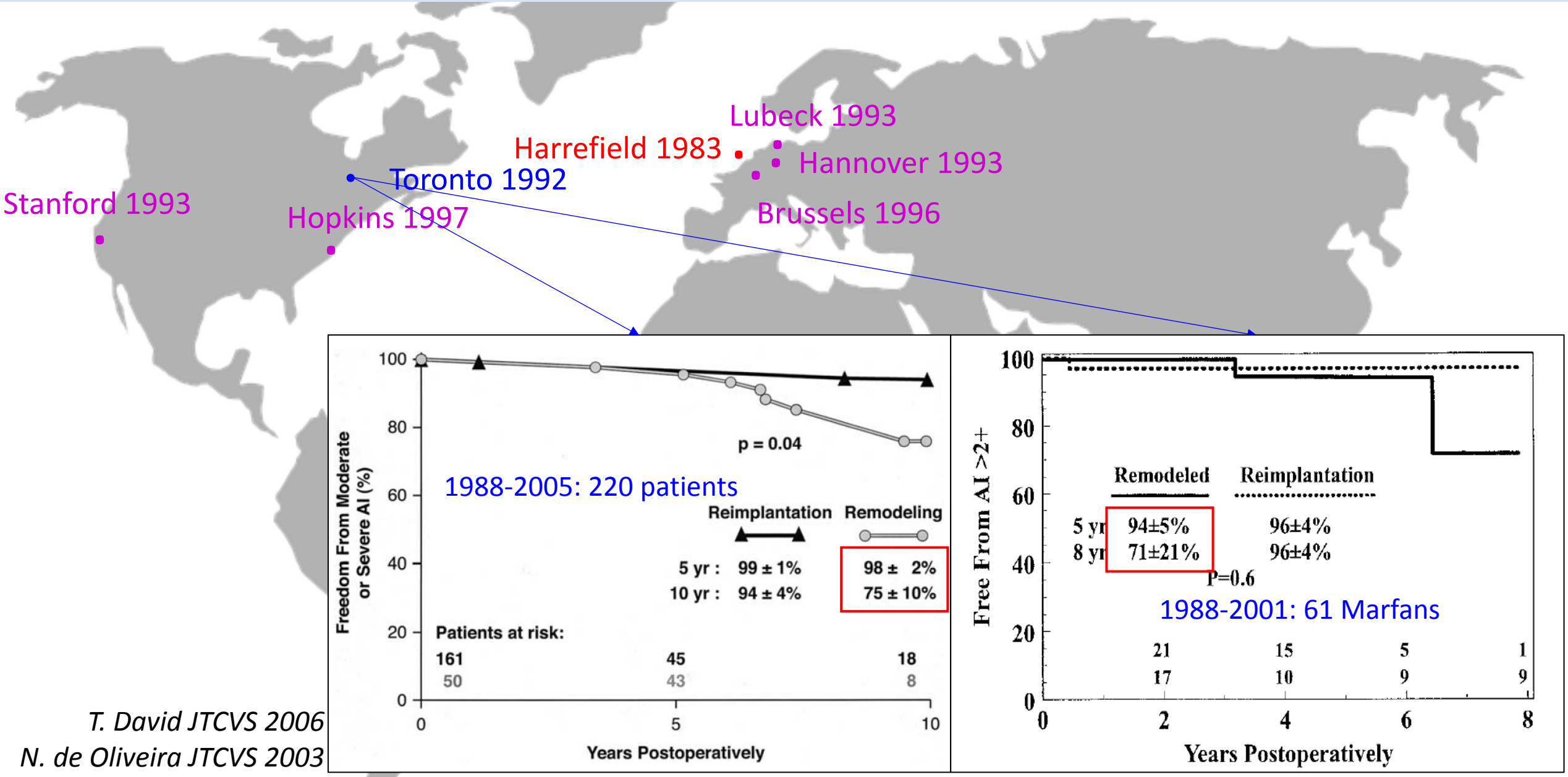
- More hemostatic
- Annuloplasty

VSRR: Doubt on Remodeling



M.H. Yacoub JTCVS 1998
E.J. Birks. Circ 1999

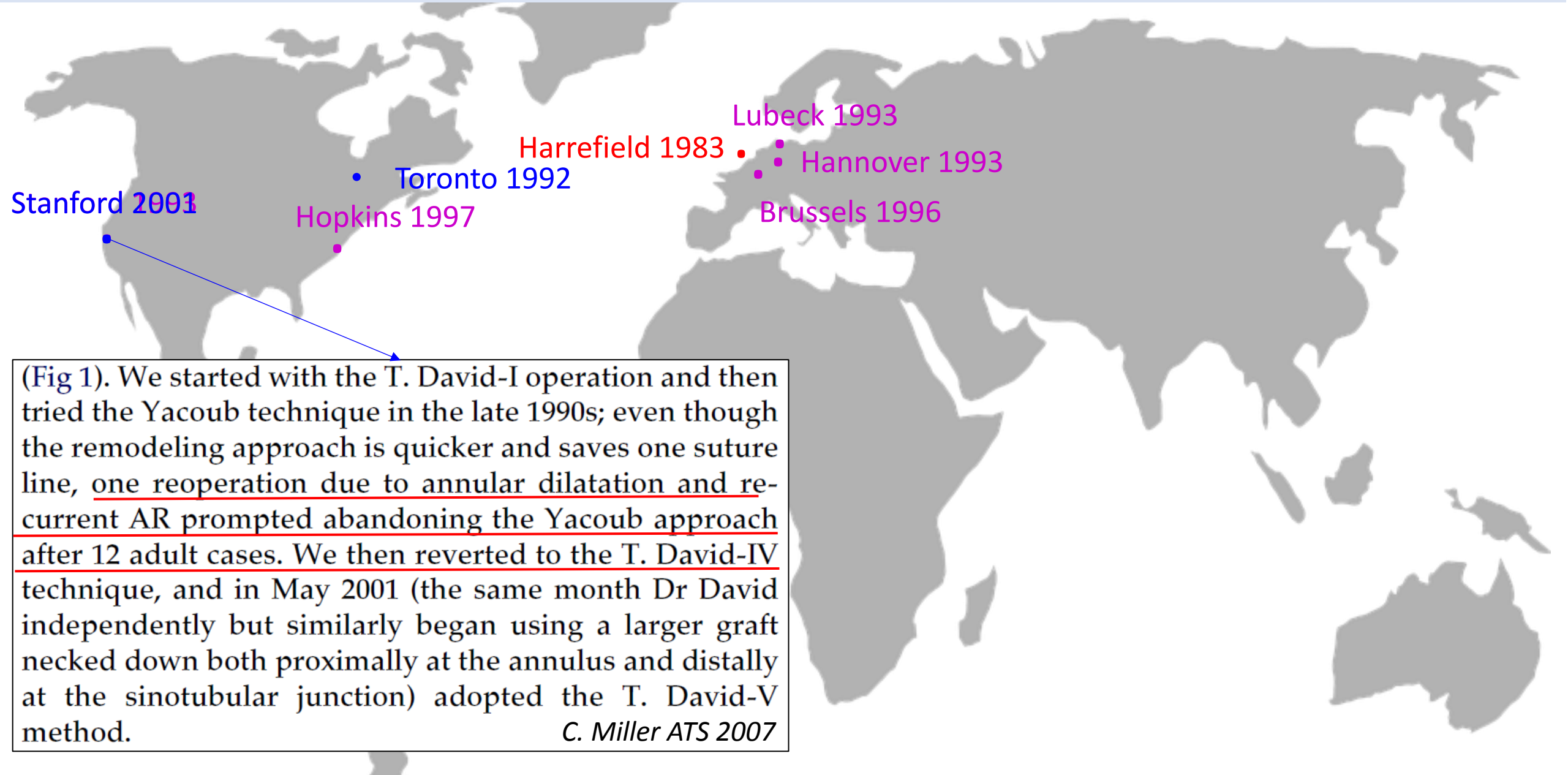
VSRR: Doubt on Remodeling



T. David JTCVS 2006

N. de Oliveira JTCVS 2003

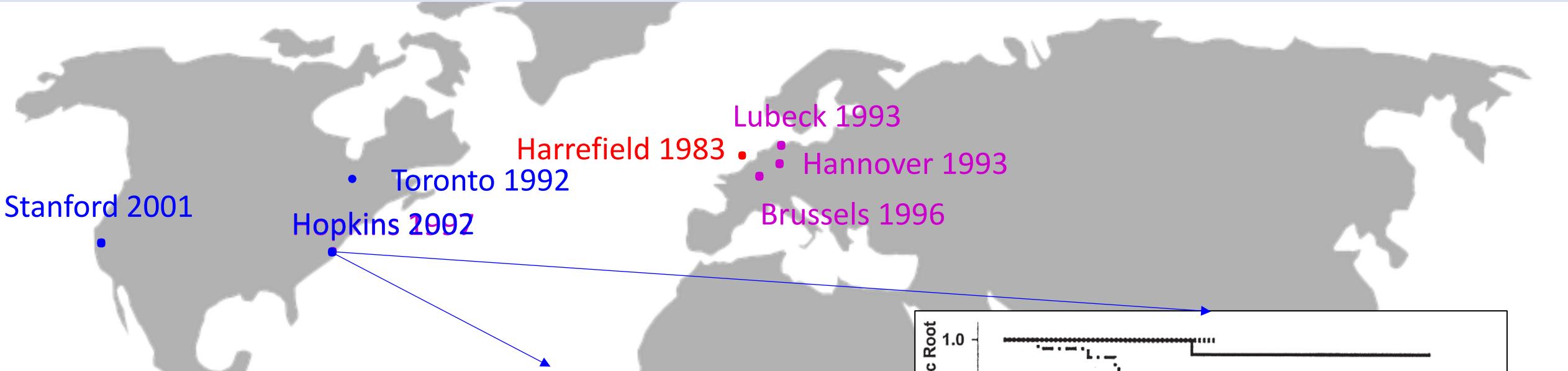
VSRR: Doubt on Remodeling



(Fig 1). We started with the T. David-I operation and then tried the Yacoub technique in the late 1990s; even though the remodeling approach is quicker and saves one suture line, one reoperation due to annular dilatation and recurrent AR prompted abandoning the Yacoub approach after 12 adult cases. We then reverted to the T. David-IV technique, and in May 2001 (the same month Dr David independently but similarly began using a larger graft necked down both proximally at the annulus and distally at the sinotubular junction) adopted the T. David-V method.

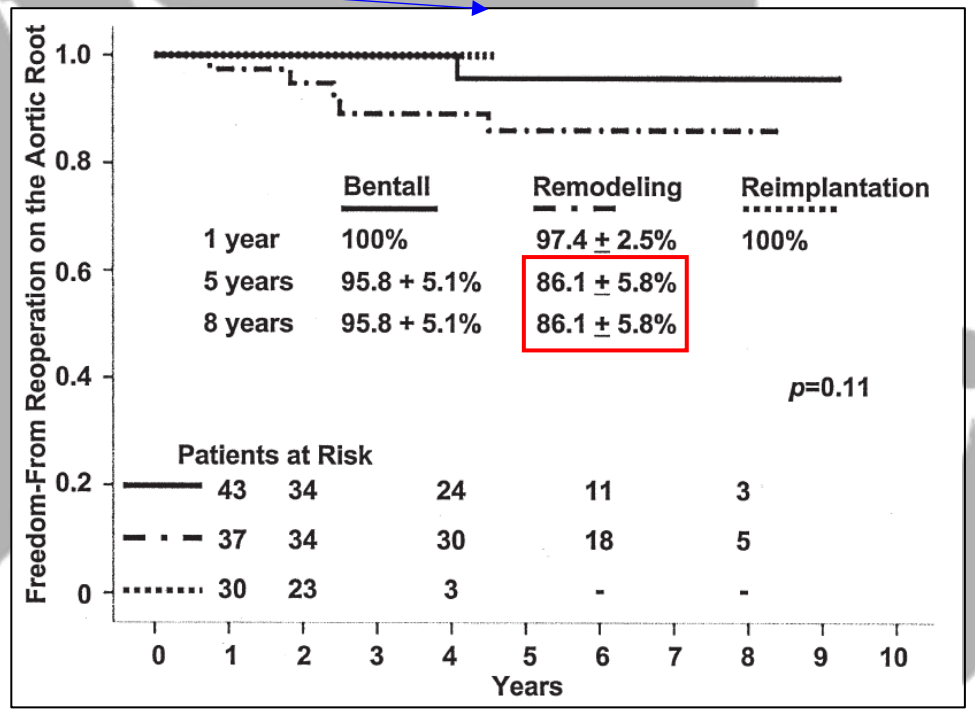
C. Miller ATS 2007

VSRR: Doubt on Remodeling



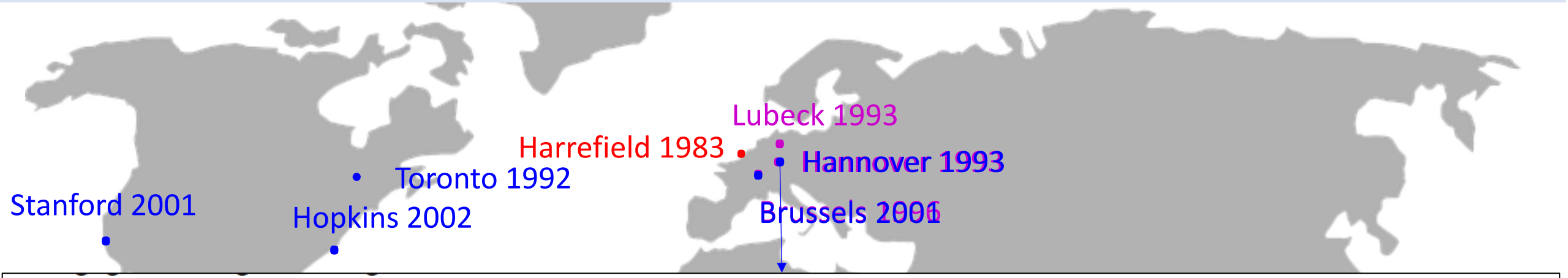
Conclusions. Aortic root replacement in children with aneurysms has low operative risk and good long-term results. Composite grafts in particular carry a low risk of endocarditis, thromboembolism, and hemorrhagic events. Homografts are suitable for small patients but lack durability. Late results with the David II remodeling valve-sparing procedure in children have been compromised by late root dilatation.

S.M. Cattaneo (Ann Thorac Surg 2004;77:168–76)

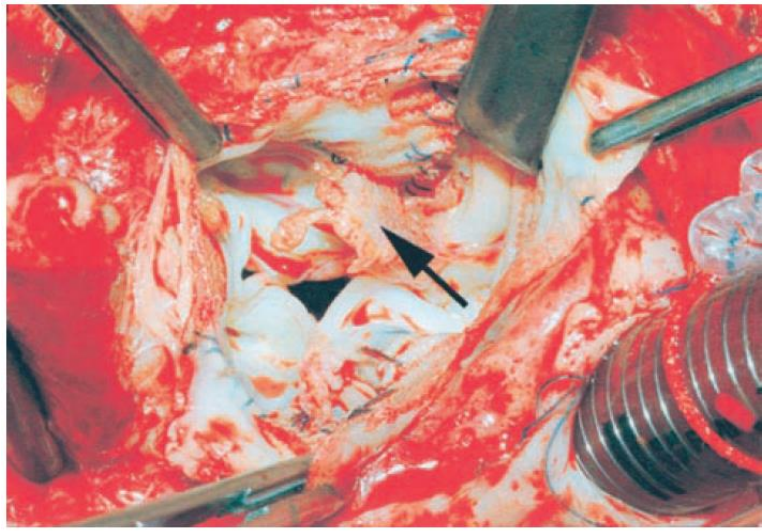


N.D. Patel ATS 2008

VSRR: Doubt on Remodeling

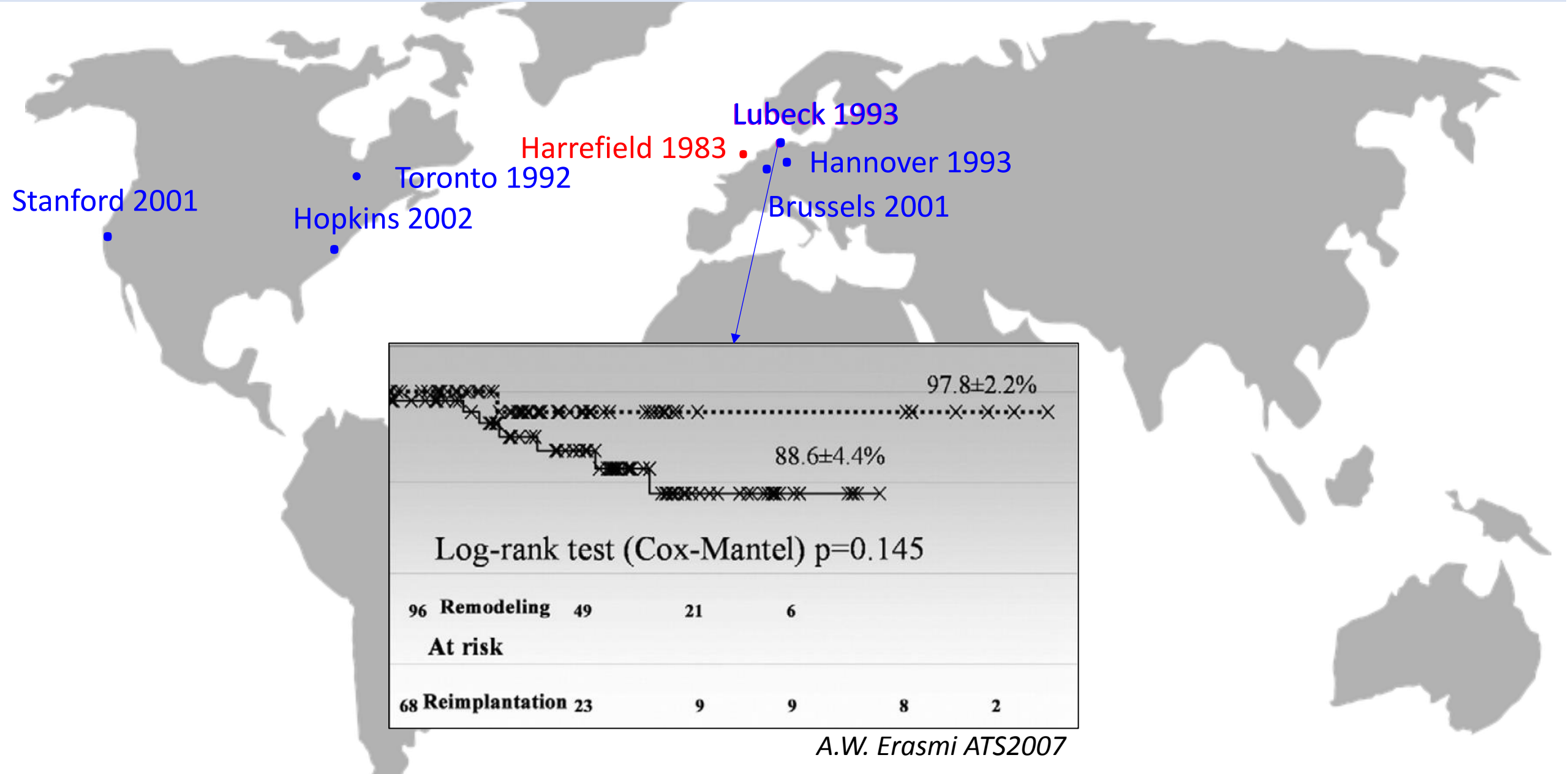


Conclusions—The high failure rate of aortic root remodeling inpatients with acute type A aortic dissection is discouraging. Whether this technique should be applied in acute type A aortic dissection is questionable. In contrast, aortic root reimplantation lead to favorable midterm outcome. Thus, we recommend consideration of this technique for surgical treatment of patients with acute type A aortic dissection. **(*Circulation*. 2002;106[suppl I]:I-229-I-233.)** *R.G. Leyh*



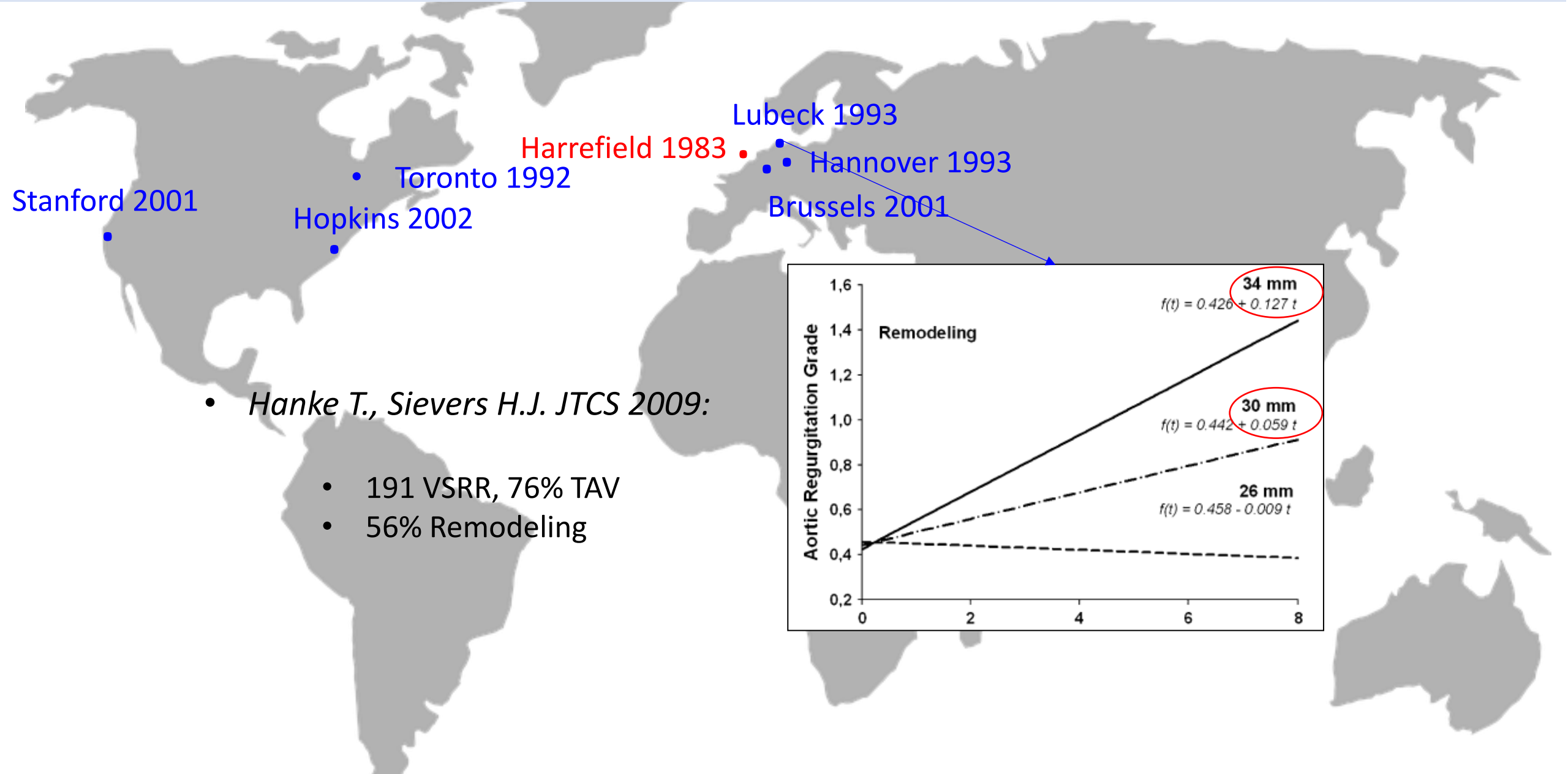
Intraoperative view of the disrupted commissure between the right and noncoronary aortic valve leaflet (arrow) 44 months after aortic root replacement with the remodeling technique for acute type A dissection.

VSRR: Doubt on Remodeling



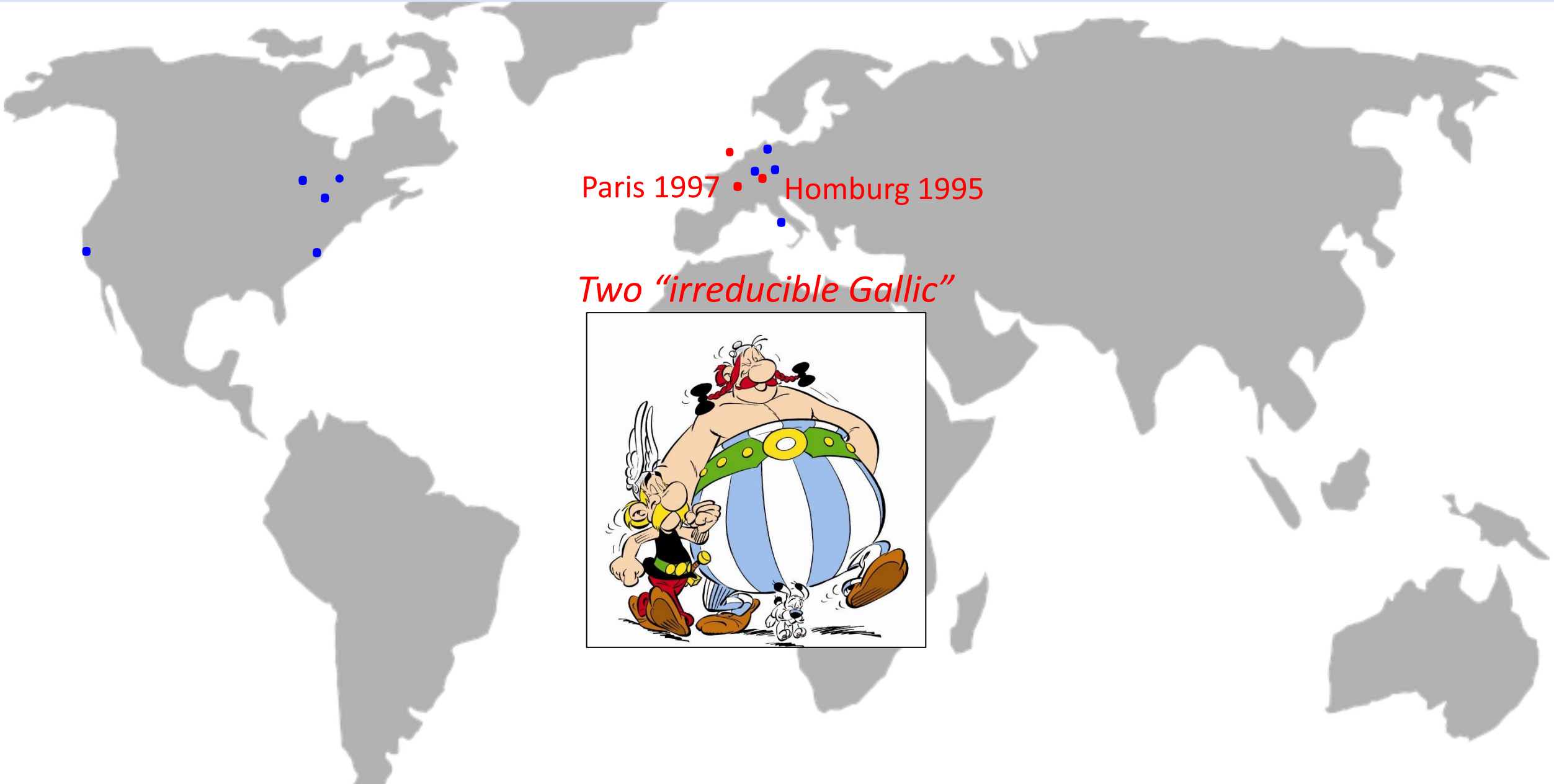
A.W. Erasmi ATS2007

VSRR: Lack of annuloplasty in Remodeling



- *Hanke T., Sievers H.J. JTCS 2009:*
  - 191 VSRR, 76% TAV
  - 56% Remodeling

VSRR: While the world was almost bleu and in peace…



Two "irreducible Gallic"

VSRR: The rational for Remodeling

Paris 1997

Homburg 1995

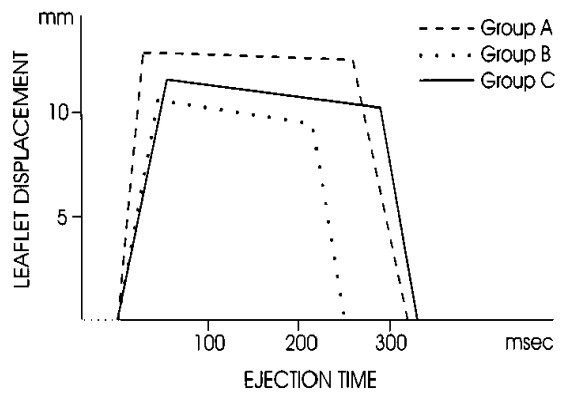


Figure 3. Diagram of 3 distinct phases of aortic valve motion pattern derived from mean values of measured data. Note faster opening and reduced slow systolic closure in group A.

R.G. Leyh Circ. 1999

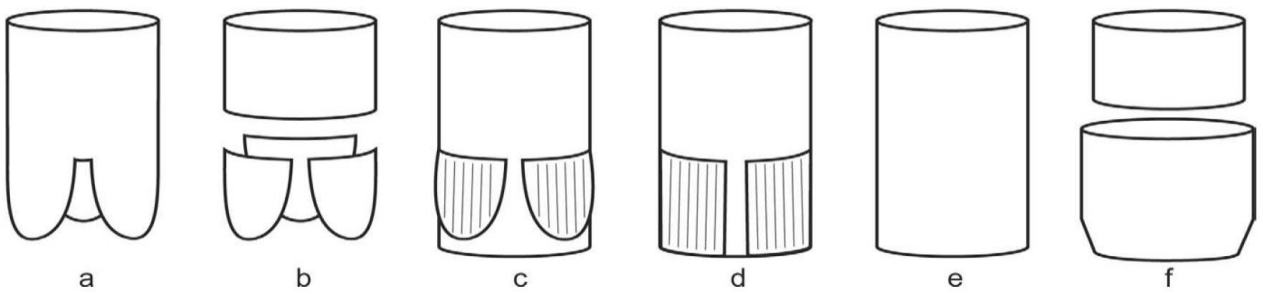


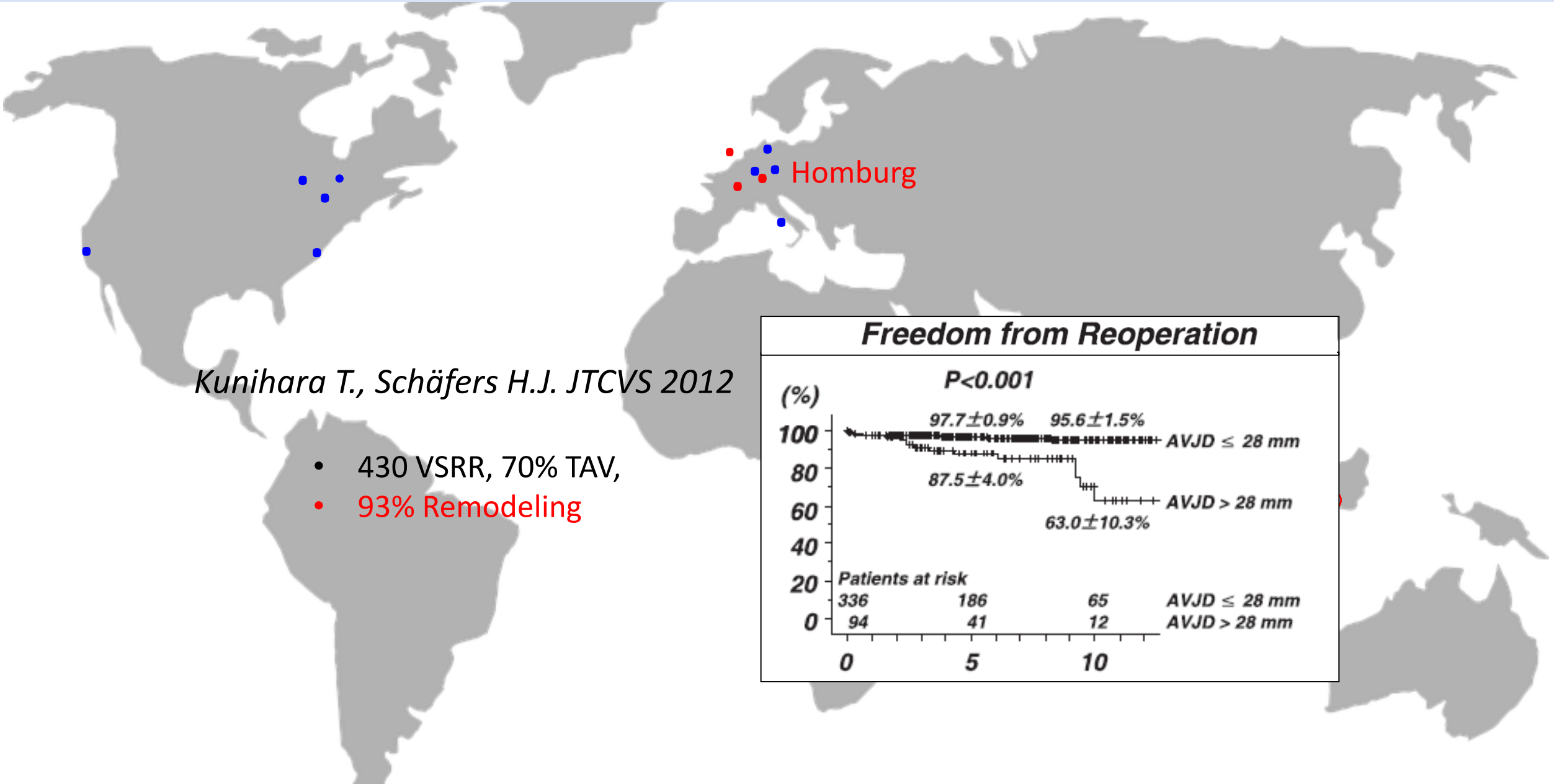
Figure 1. Schematic drawings of the different valve-sparing techniques. *Left to right:* remodeling, modified remodeling, sinus prosthesis, modified sinus prosthesis, reimplantation, and modified reimplantation.

Conclusions: In vitro the various aortic valve–sparing operations differed characteristically in their ability to spare valve function, none of them completely meeting native valve behavior. The remodeling techniques exhibited valve dynamics closest to those of the native aortic root. The more the aortic valve is fixed with noncompliant prosthetic material, the more the native root dynamics are impaired.

A. Erasmi JTCVS 2005

- Snapshot, close to native AV dynamics in VSRR does not mean durability!
- Lack of annuloplasty seems to be a much stronger predictor of durability

VSRR: Lack of annuloplasty in Remodeling

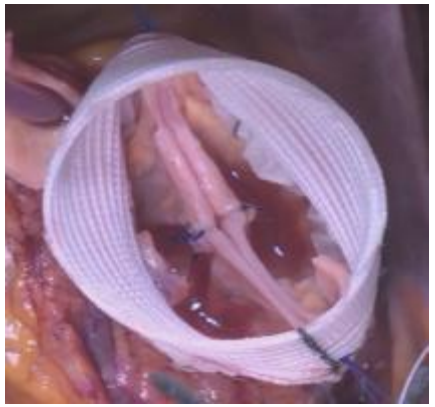


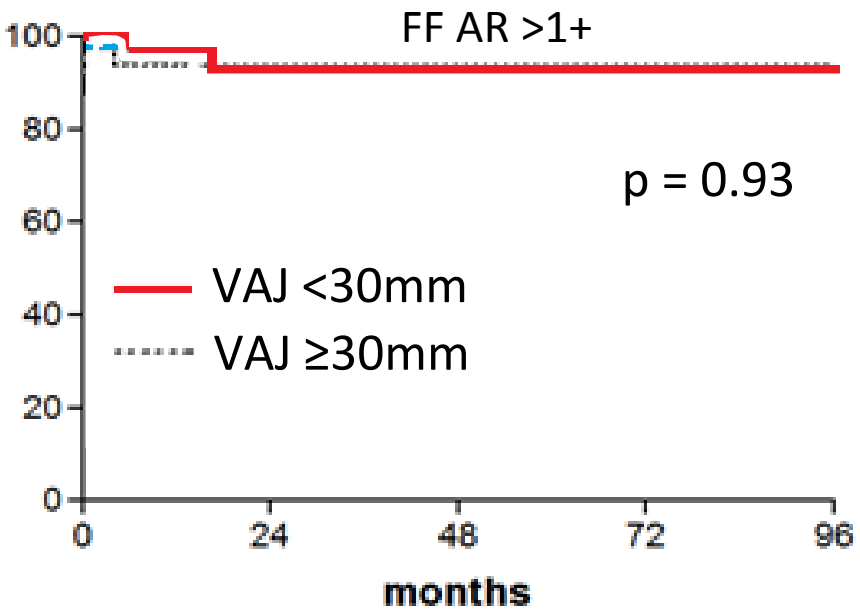
Kunihara T., Schäfers H.J. JTCVS 2012

- 430 VSRR, 70% TAV,
- 93% Remodeling

VSRR: Annuloplasty in Reimplantation

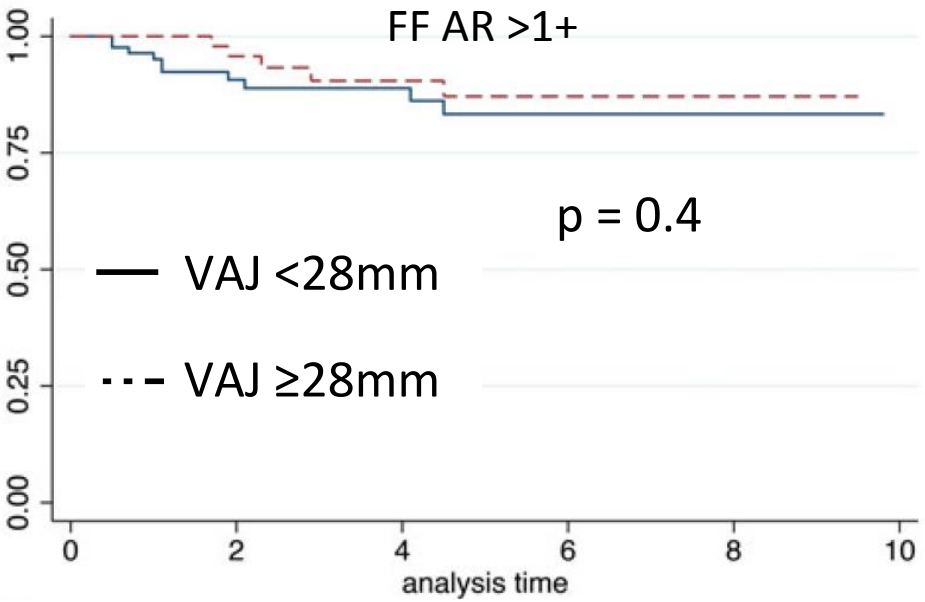
BAV





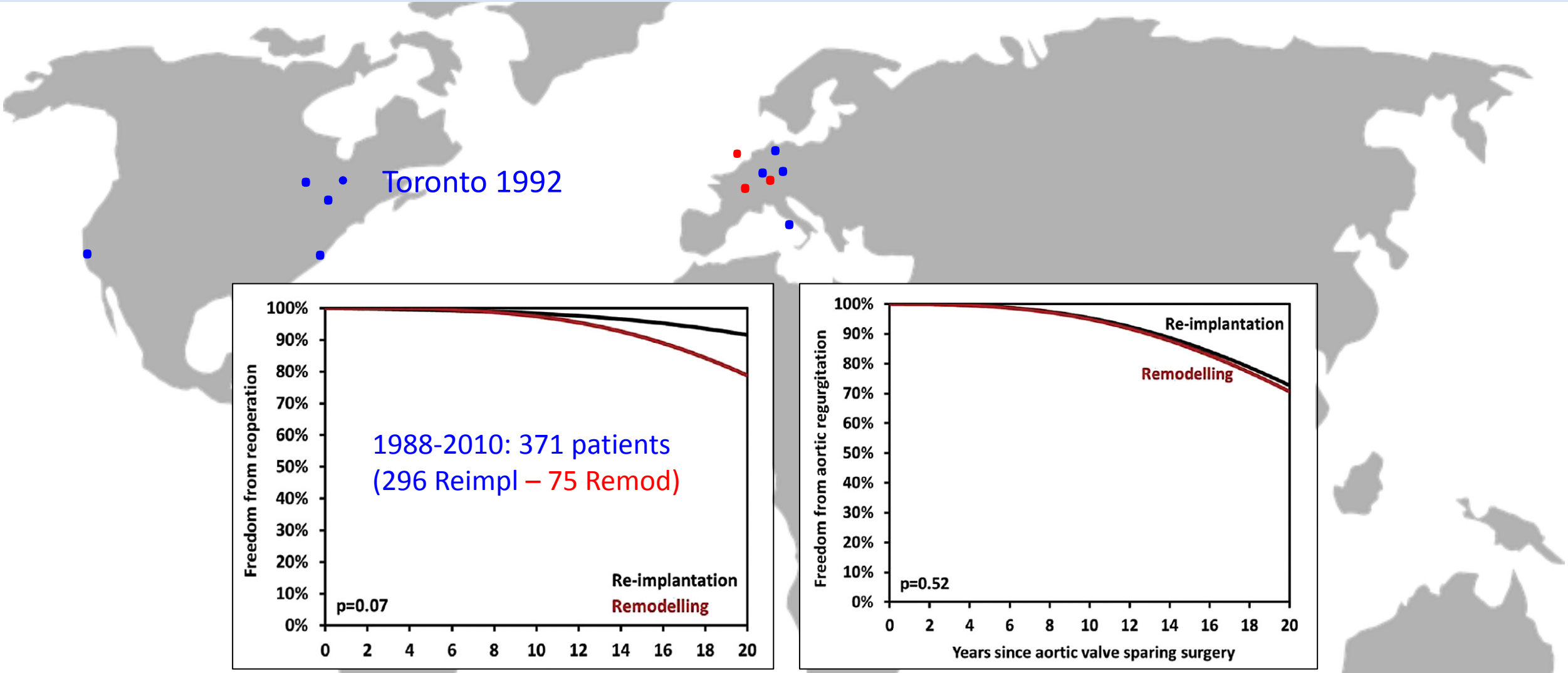
Navarra E. EJCTS 2013

TAV



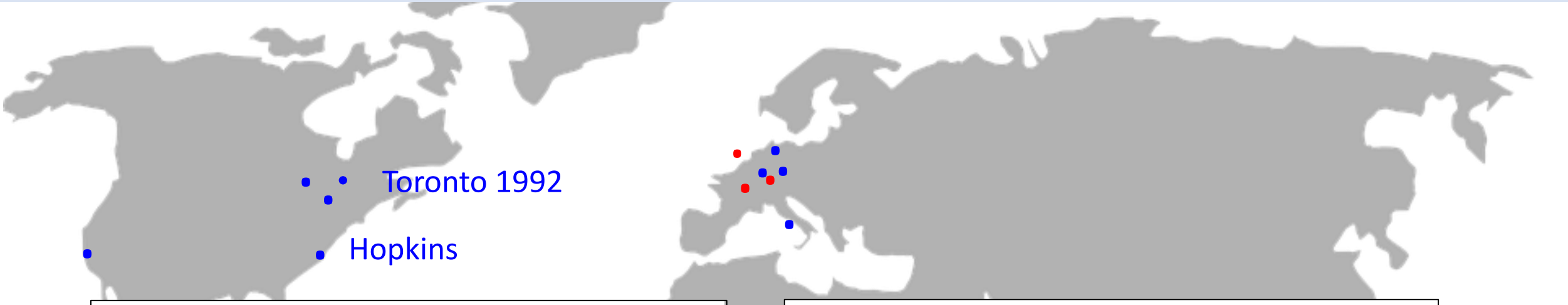
De Kerchove L. EJCTS 2015

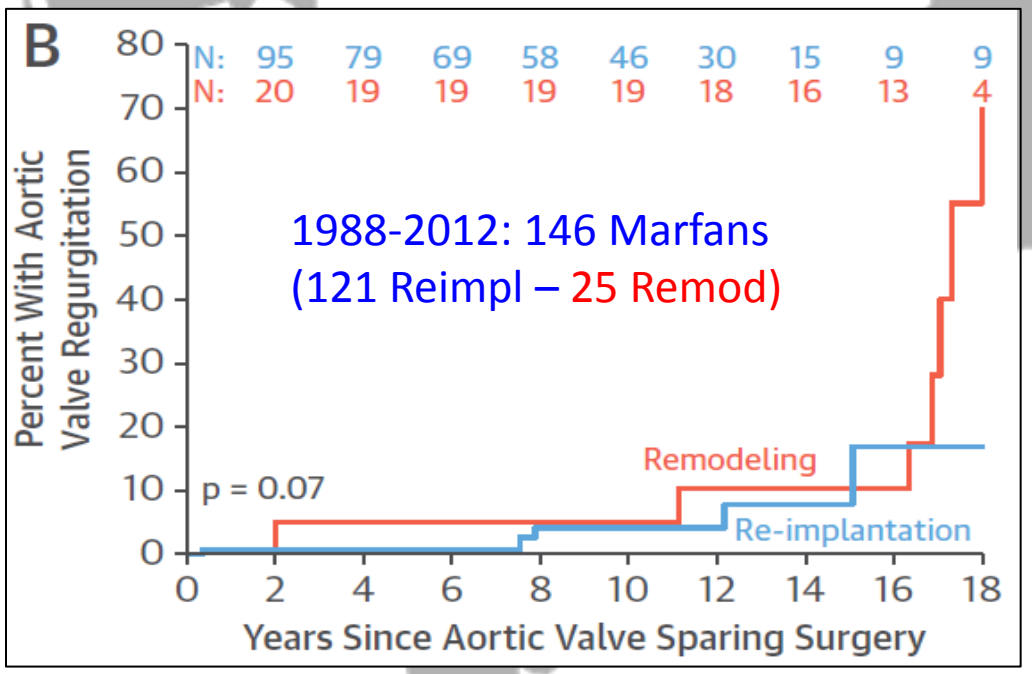
VSRR: Longest term results of Reimplantation vs Remodeling



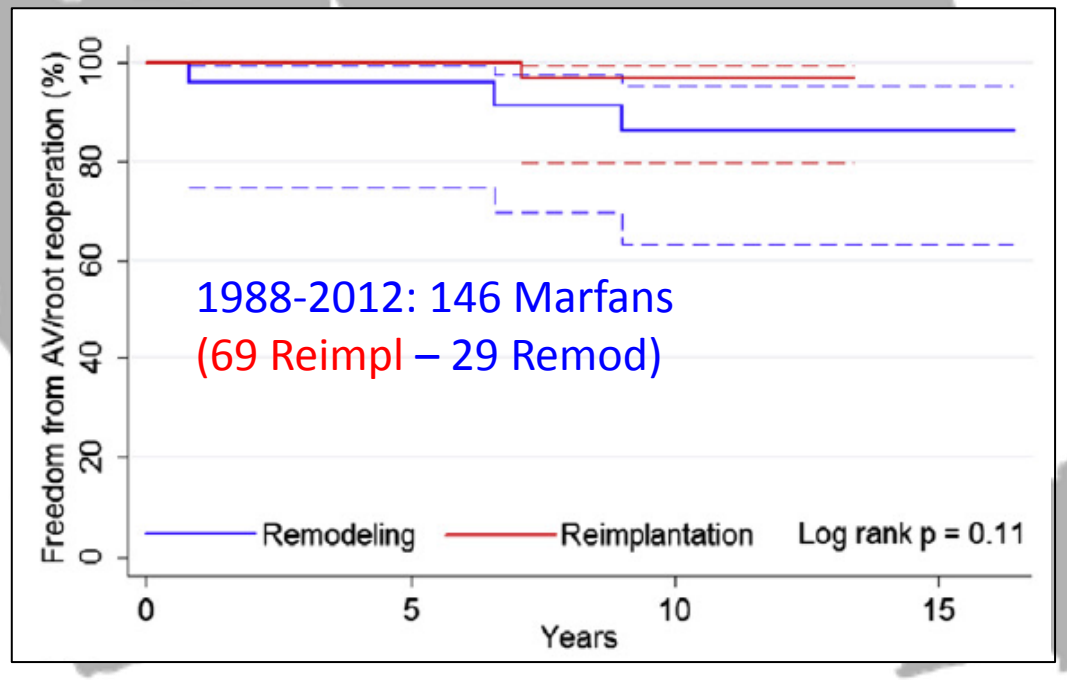
T. David JTCVS 2014

VSRR: Longest term results of Reimplantation vs Remodeling



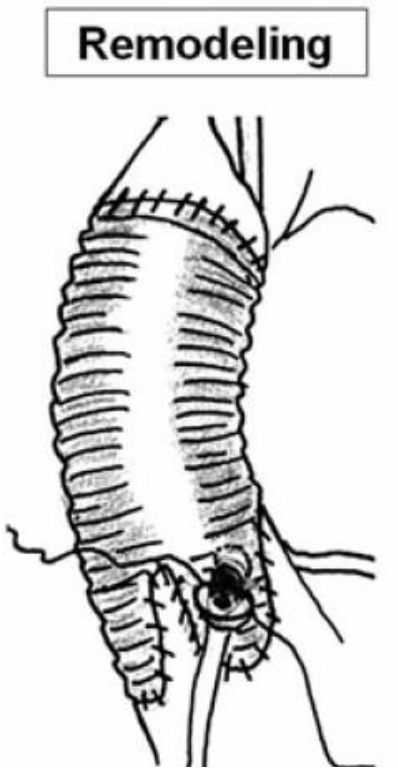


T. David JACC 2015

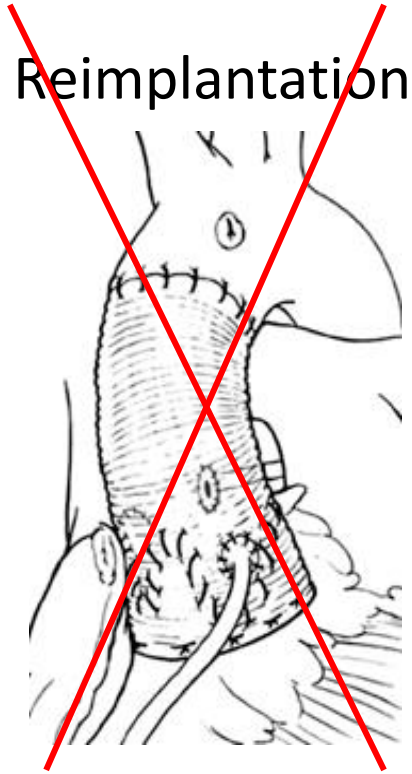


J. Price JTCVS 2016

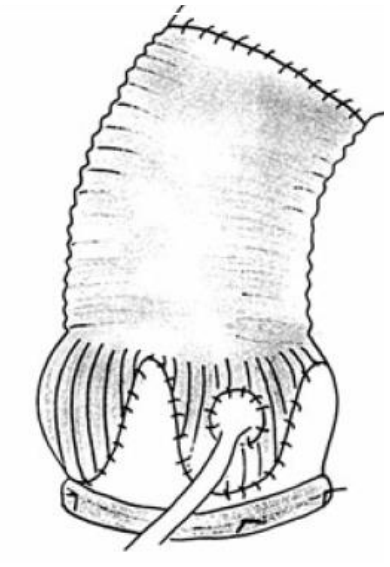
VSRR: Evolution of the Remodeling technique



Reimplantation



Circumferential external band



E. Lansac 2006 (started in 2003)

Suture Annuloplasty

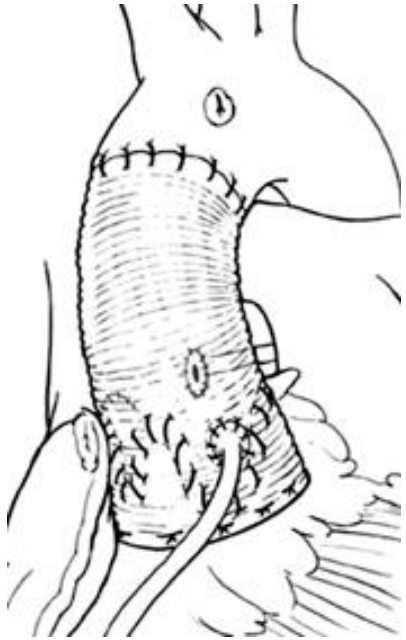
H.J. Schäfers 2013 (started 2008)

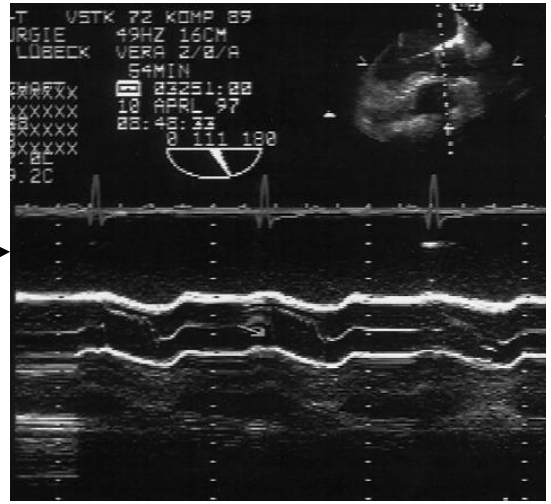
But…

- Operative time !
- Root dissection !
- AV dynamics ?
- Improve durability ?

VSRR: Doubt on the Reimplantation technique

Reimplantation

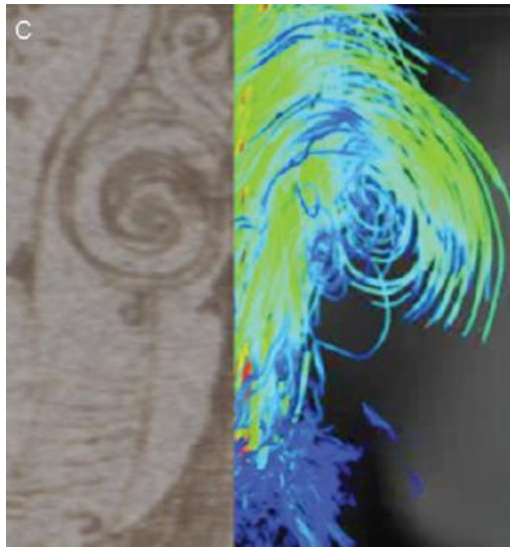




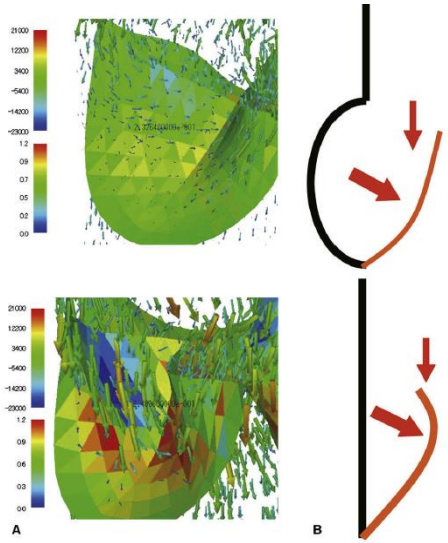
R.G. Leyh Circ. 1999

→ Risk of cusp damage and rapid deterioration of the valve !

✓ Only very occasionally reported, incidence ?
Do not induce clinically significant impact



Bissell M. Eur Heart J. 2014

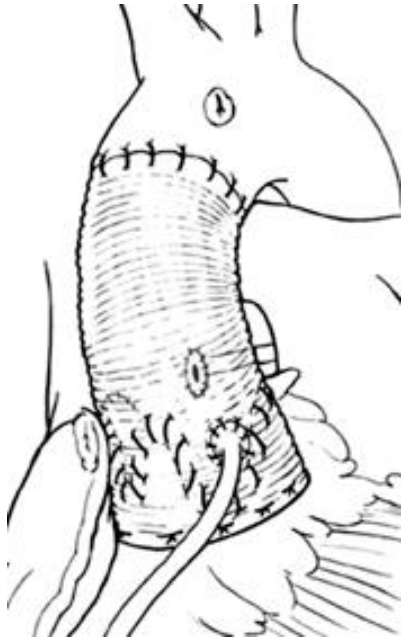


Katayama JTCVS 2008

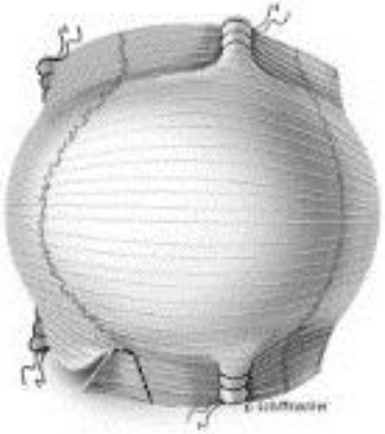
✓ Max valve opening
✓ coronary vascularisation
✓ “Stress less” opening/closure

VSRR: Evolution of the Reimplantation technique

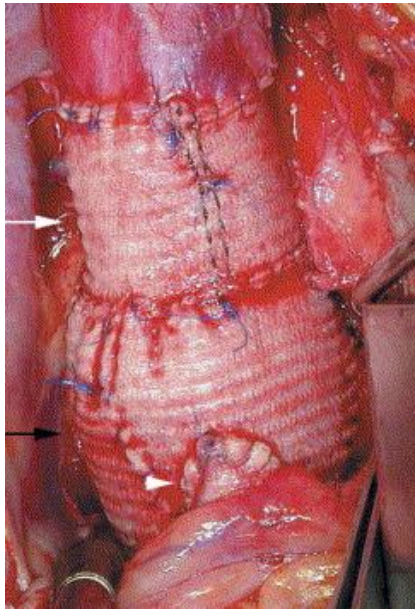
Reimplantation



David V



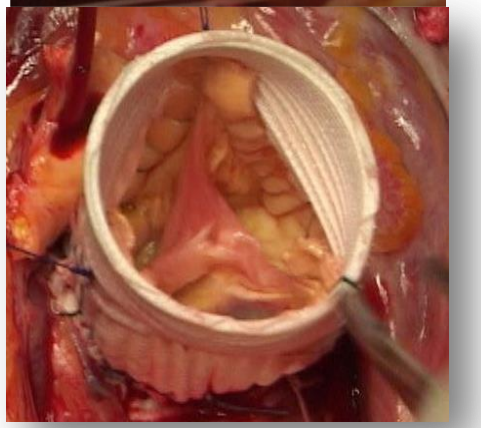
Stanford Modification



C. Miller

Sinus Graft

Valsalva®



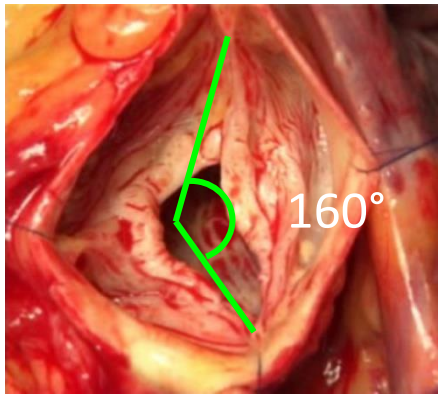
R. De Paulis 2002

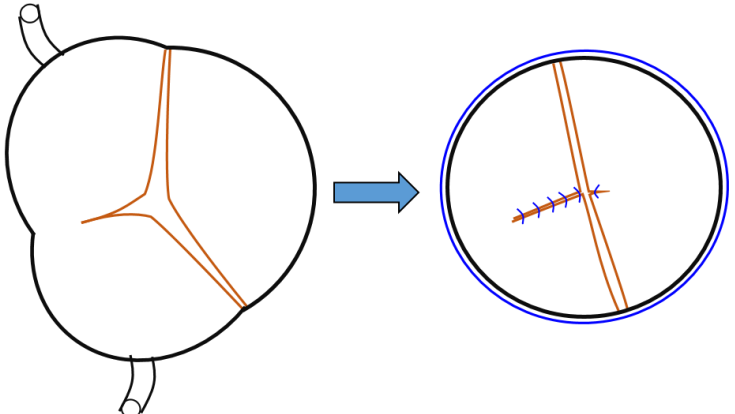
VSRR: *Why Reimplantation should be preferred*

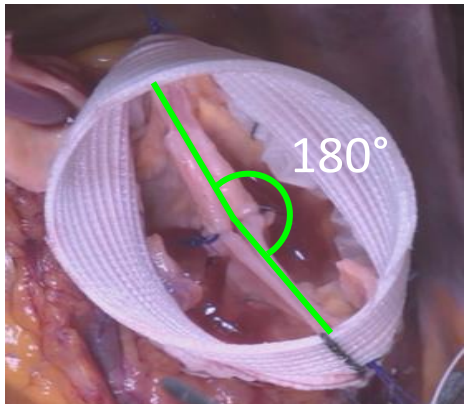
- ✓ Safe and reproducible, disseminated worldwide
- ✓ Proven durability up to 15y in TAV, BAV, Marfans and dissection
- ✓ One sizing, one device (graft) (≠ Remodeling + annuloplasty)

  → Costs of the procedure !

- ✓ Ability to modify valve geometry (from asymmetric BAV to 180°symmetric configuration) (≠ Remodeling ± annuloplasty)



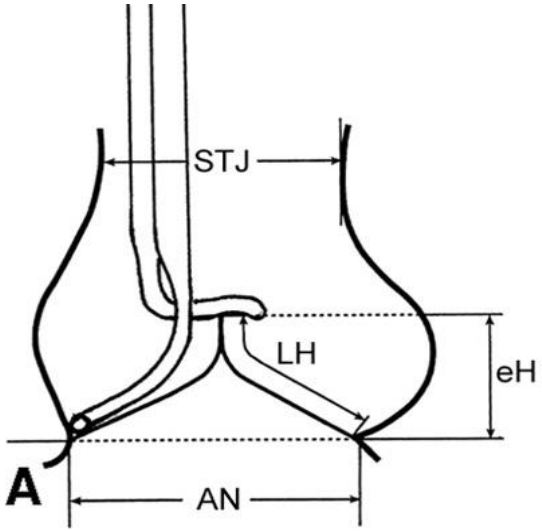




VSRR: *Why Reimplantation should be preferred*

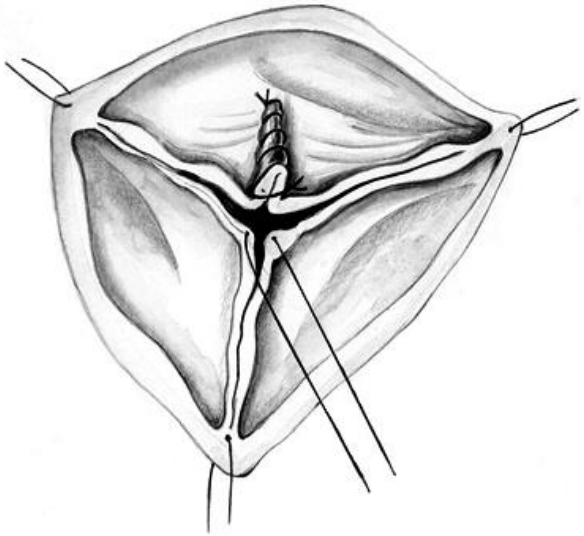
But, excellent long term durability can be achieve in Reimplantation only if

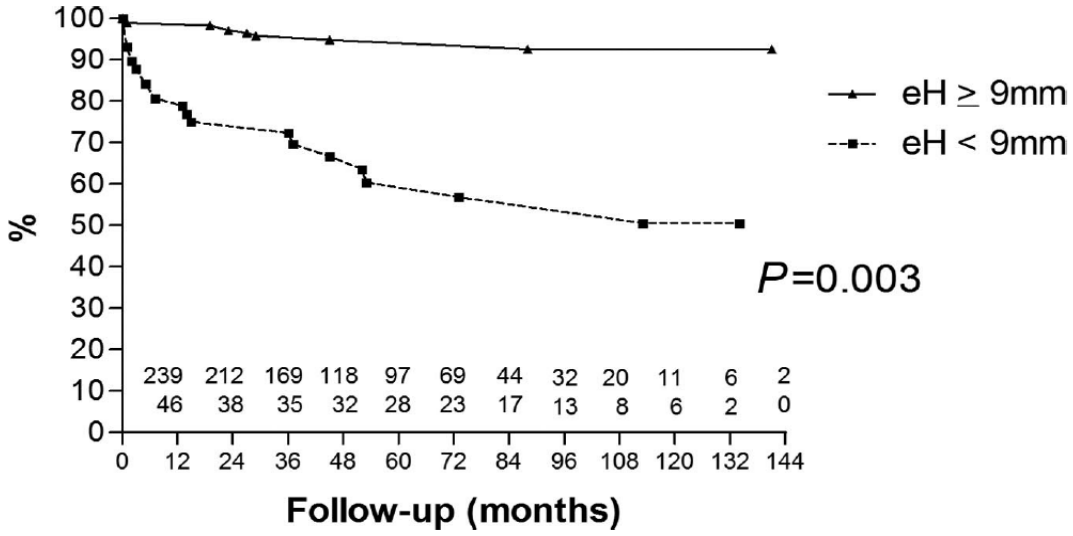
- ✓ Technical pitfalls avoided (sizing, commissure resuspension)
- ✓ Appropriate cusp management



Schäfers HJ. JTCVS 2006

Central Cusp Plication



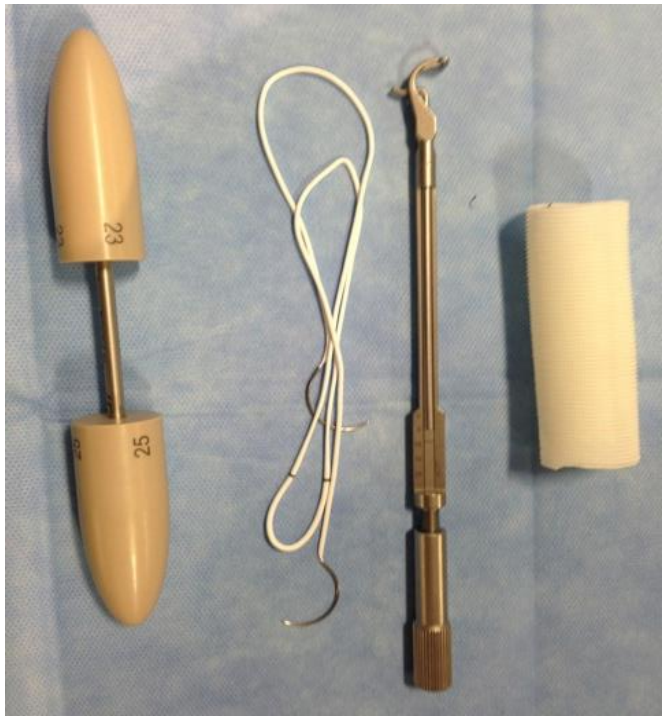


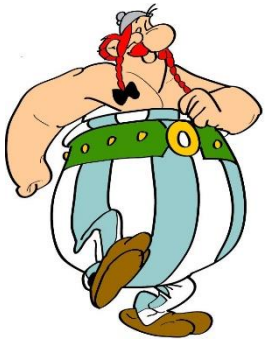
Aicher D. Circ. 2011

VSRR: *Wathever the technique you choose,* ***do a Reimplantation !***

Brussels Gallic's Technique

Homburg Gallic's technique



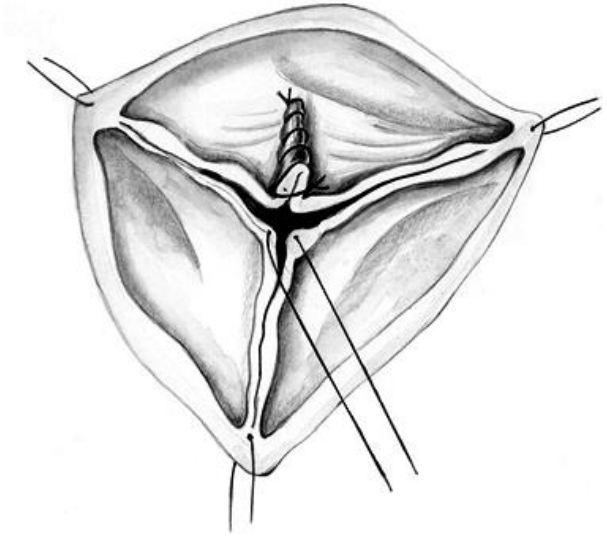


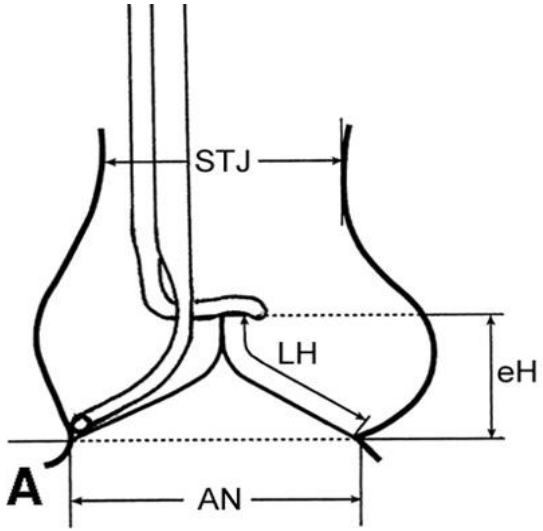
Paris Gallic's technique

Thank you

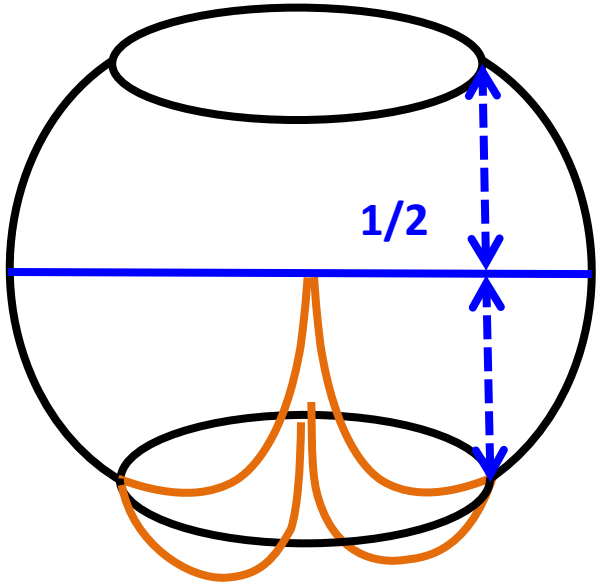
VSRR: How to do it ?

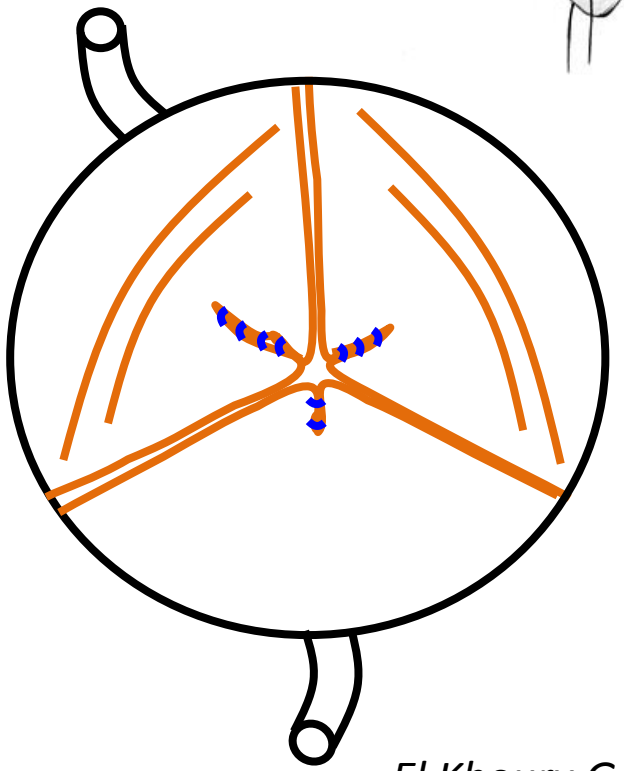
Central Cusp Plication



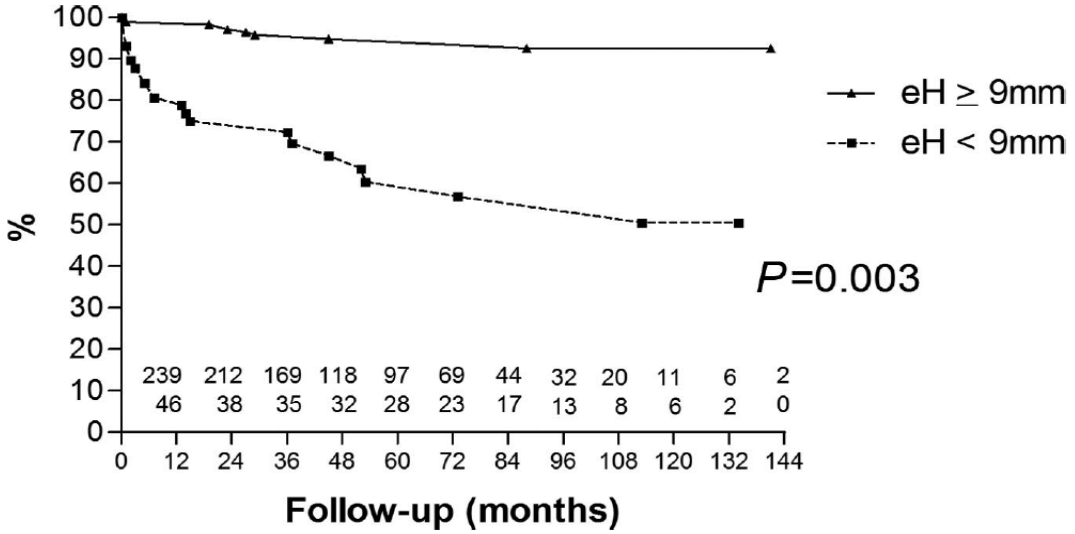


Schäfers HJ. JTCVS 2006



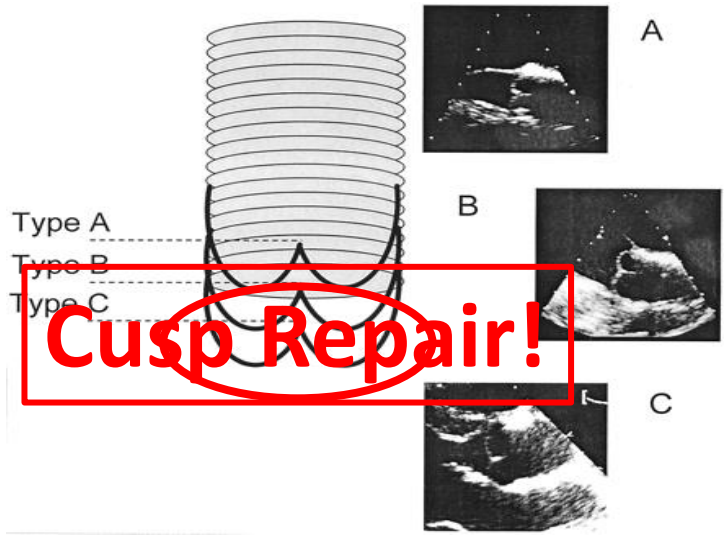


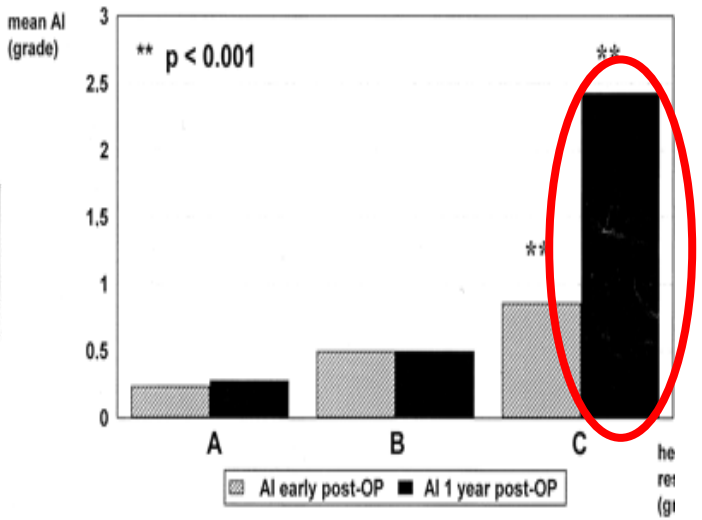
El Khoury G.



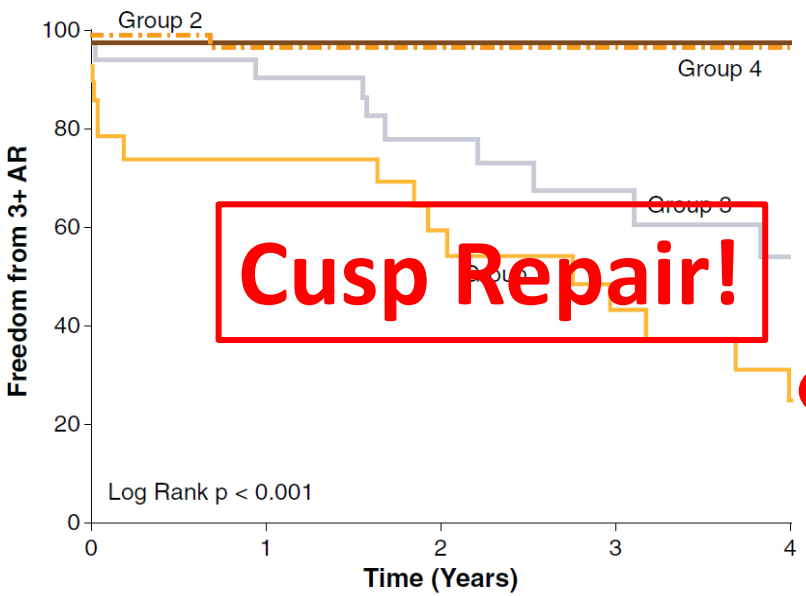
Aicher D. Circ. 2011

VSRR: How to do it ?





Pethig K. ATS 2002



Tips > annulus, No AR
Residual AR, Coapt >4 mm

Tips > annulus
Residual AR
Coapt < 4 mm

Tips < annulus

le Polain JB. JACC Card. Im. 2009

VSRR: How to do it ?

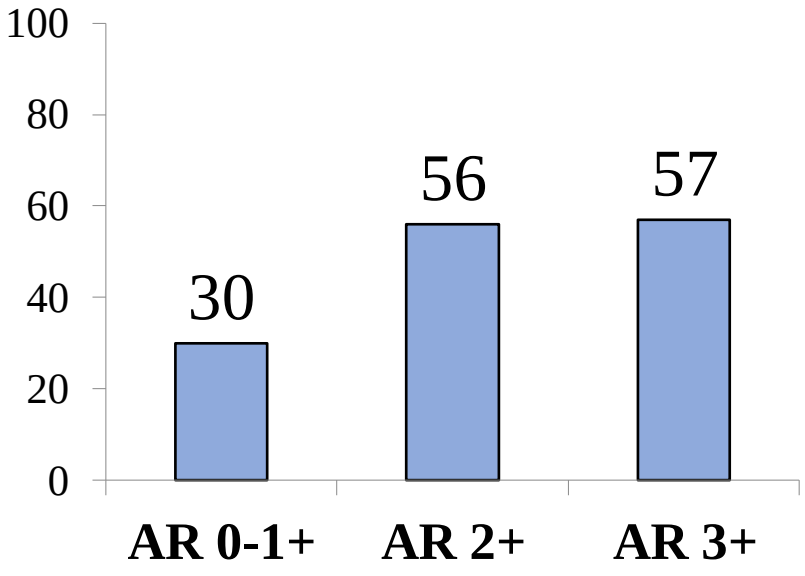
- Rate of cusp repair in VSRR

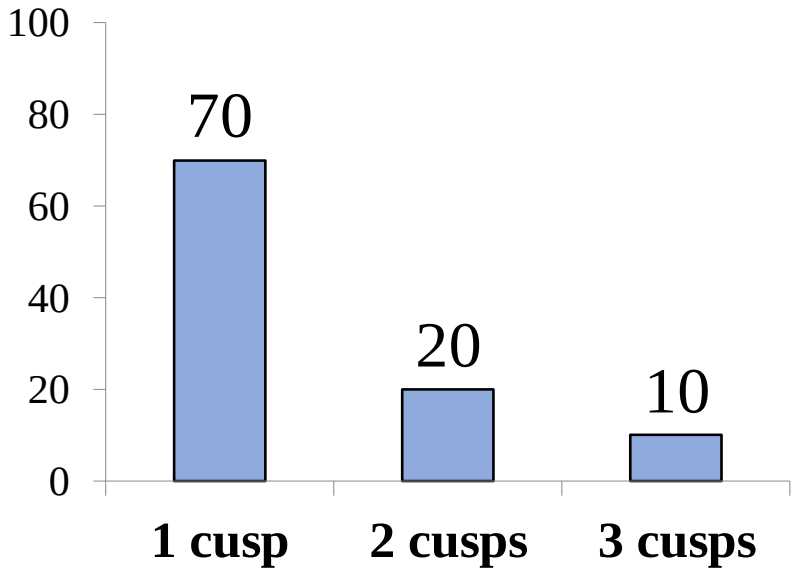
TAV

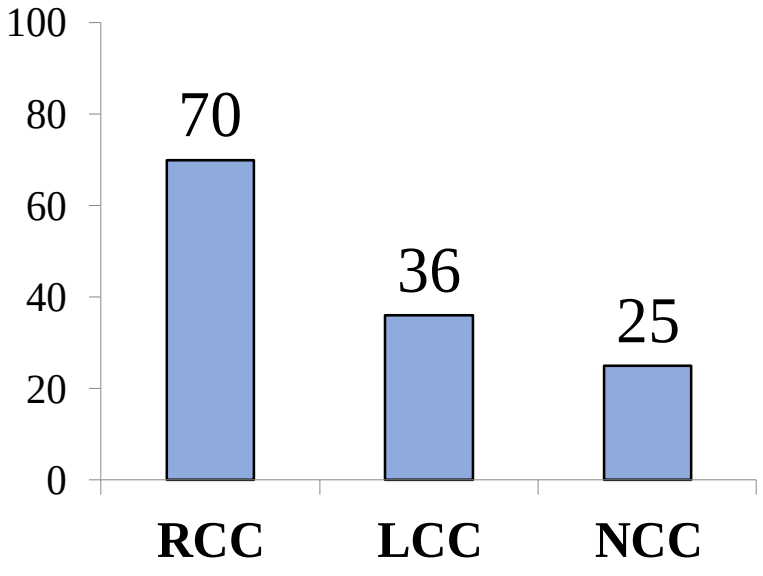
- El Khoury 53% Reimplantation
- David ≈ 60% mixte
- Schäfers ≈ 90% Remodeling

BAV

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

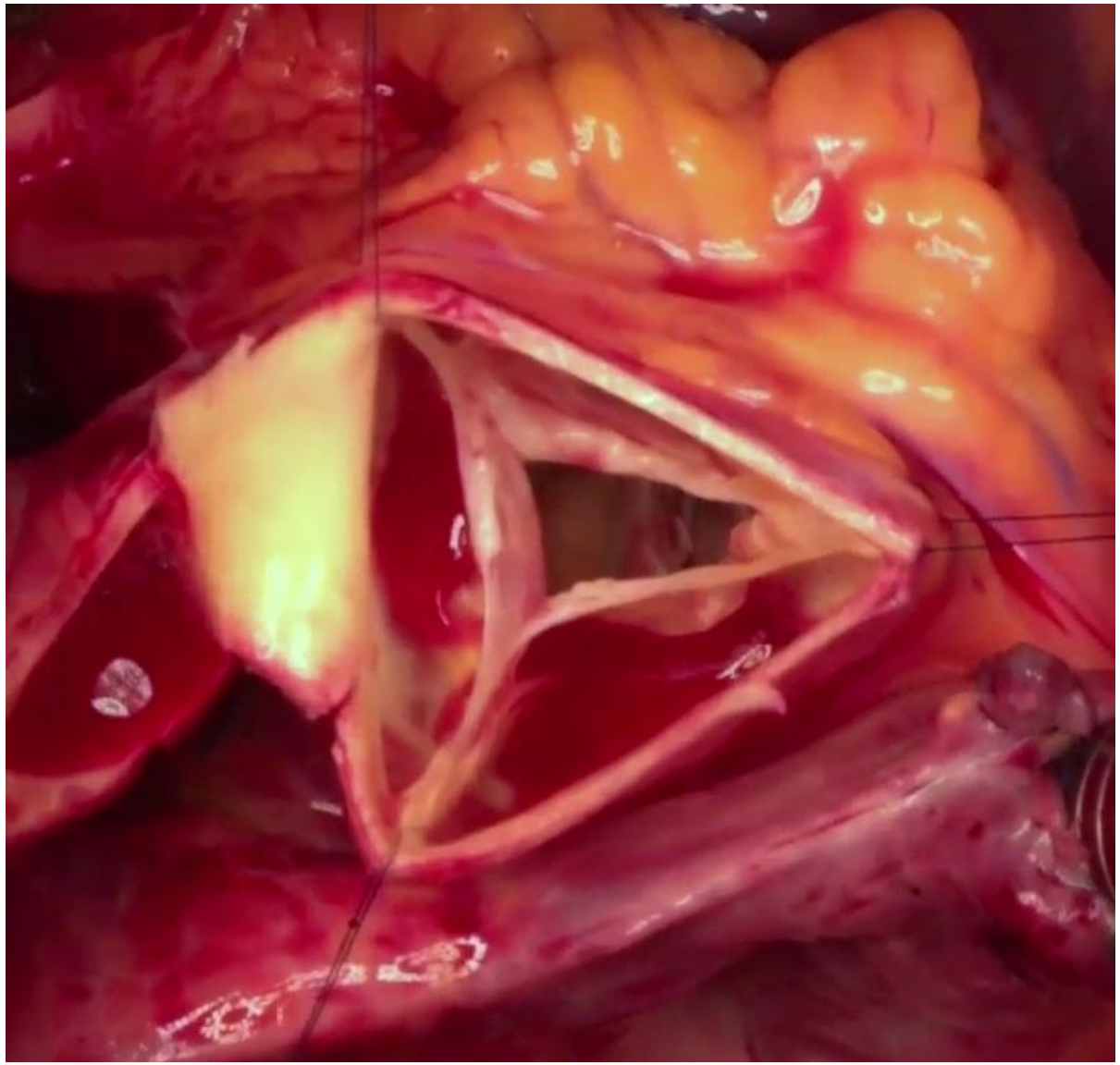






VSRR: How to do it ? Brussels Technique

1. **Valve inspection**
2. Root dissection
3. Complex cusp repair
4. Graft sizing & proximal suture line
5. Com. reimplantation & distal suture line
6. Residual prolapse repair
7. Coronary reimplantation



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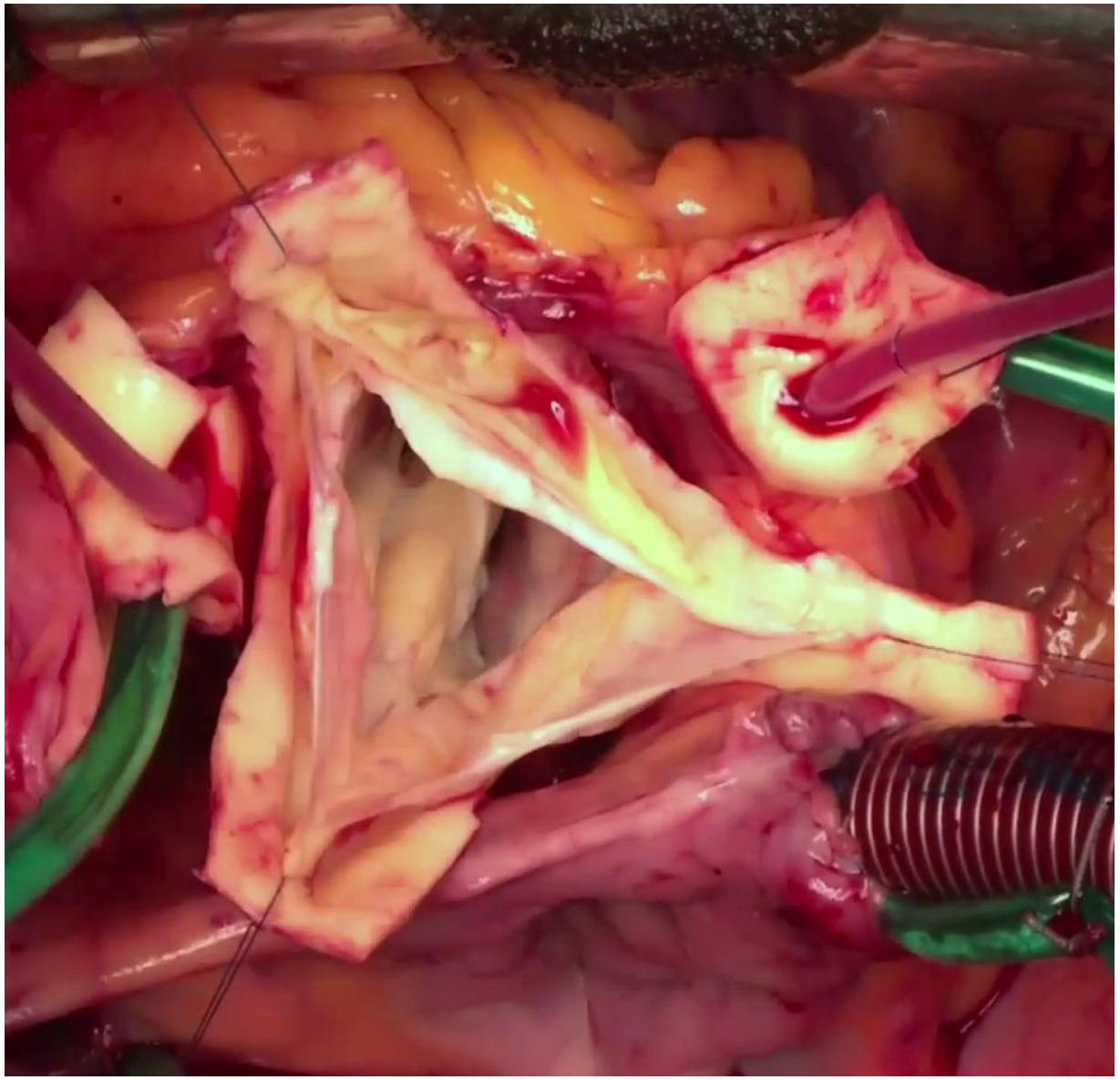

VSRR: How to do it ? Brussels Technique

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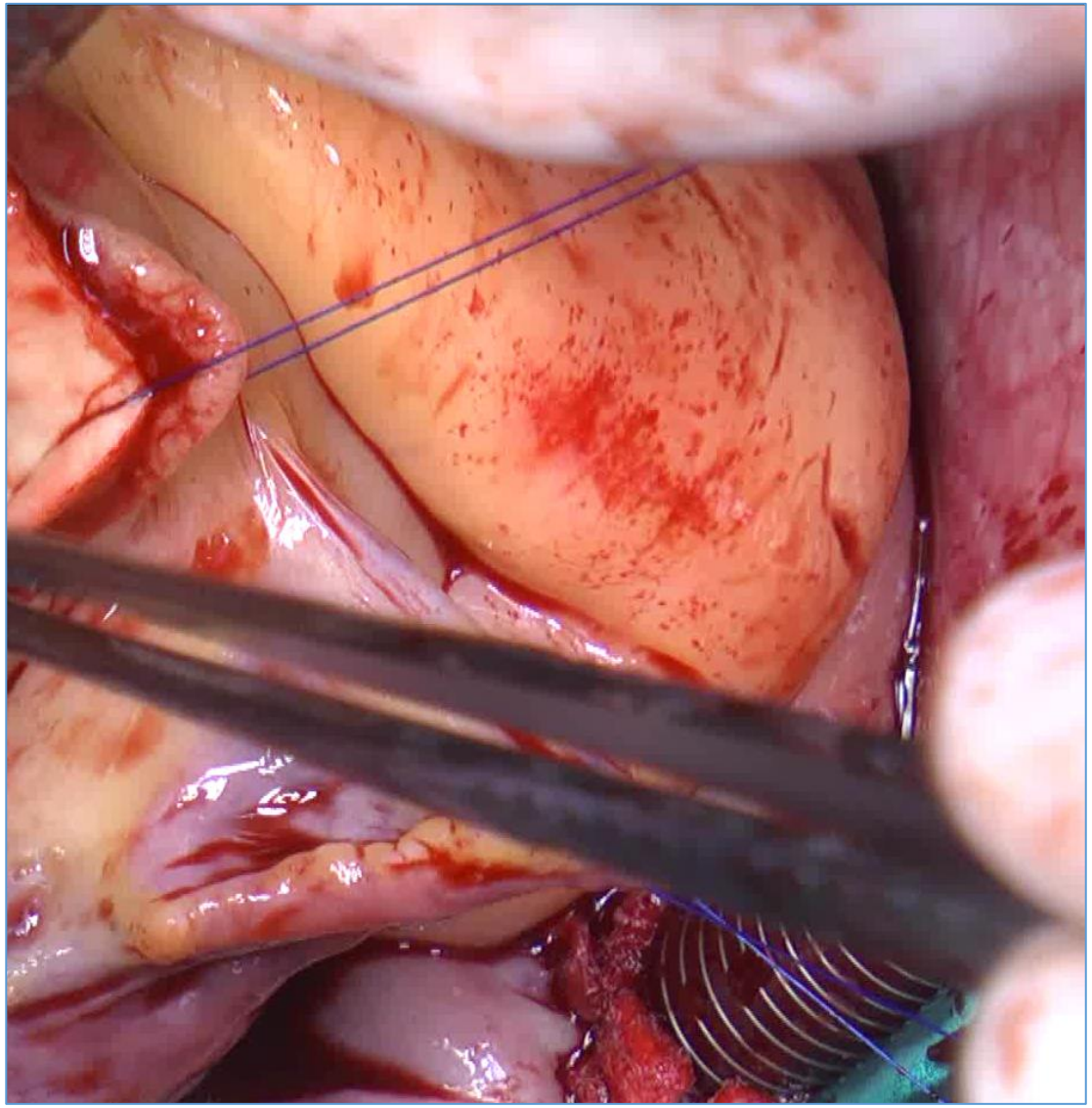

VSRR: How to do it ? Brussels Technique

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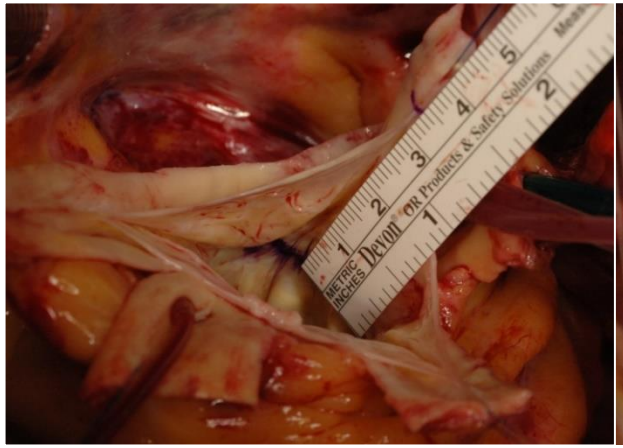

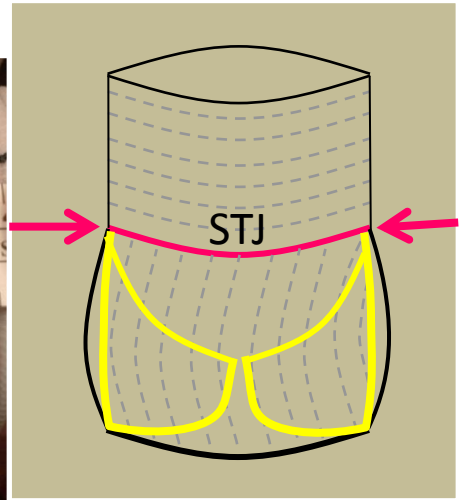

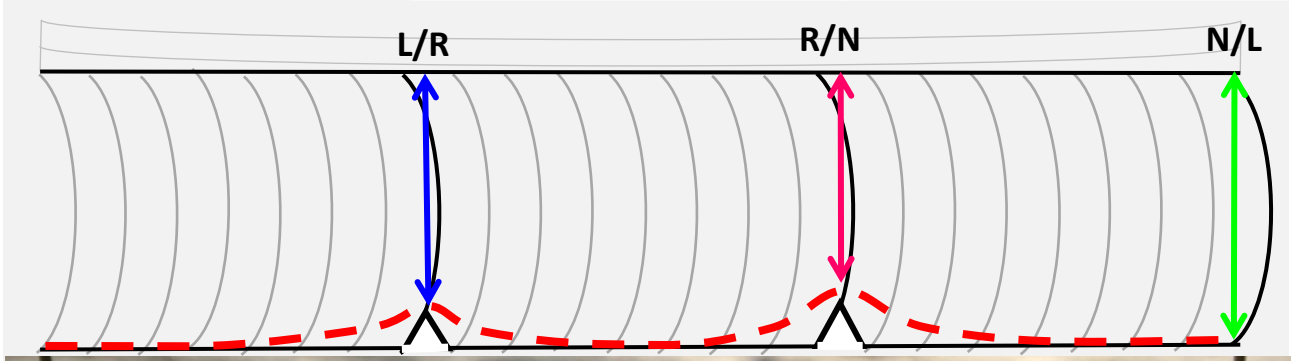

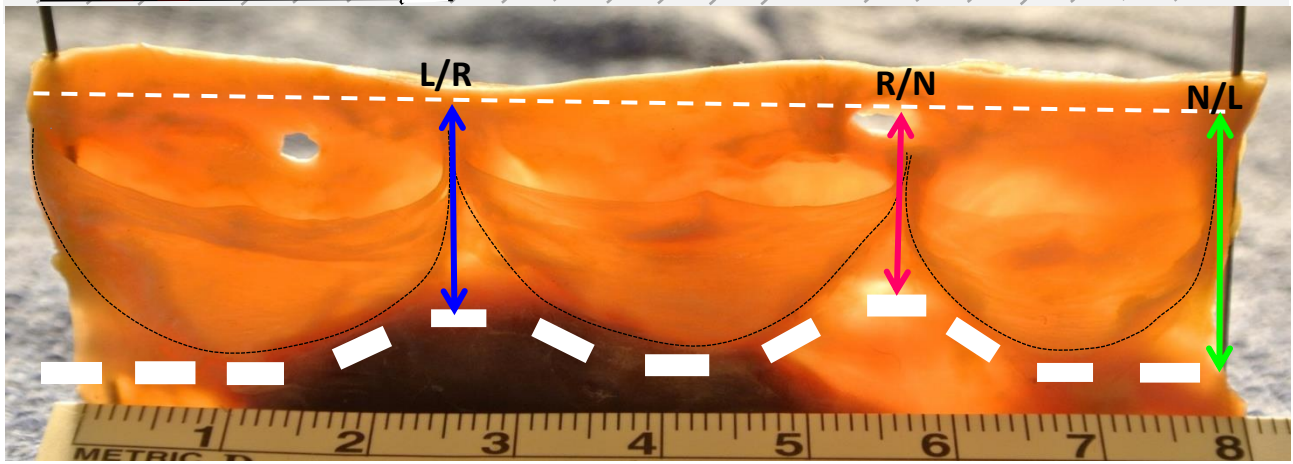

VSRR: How to do it ? Brussels Technique

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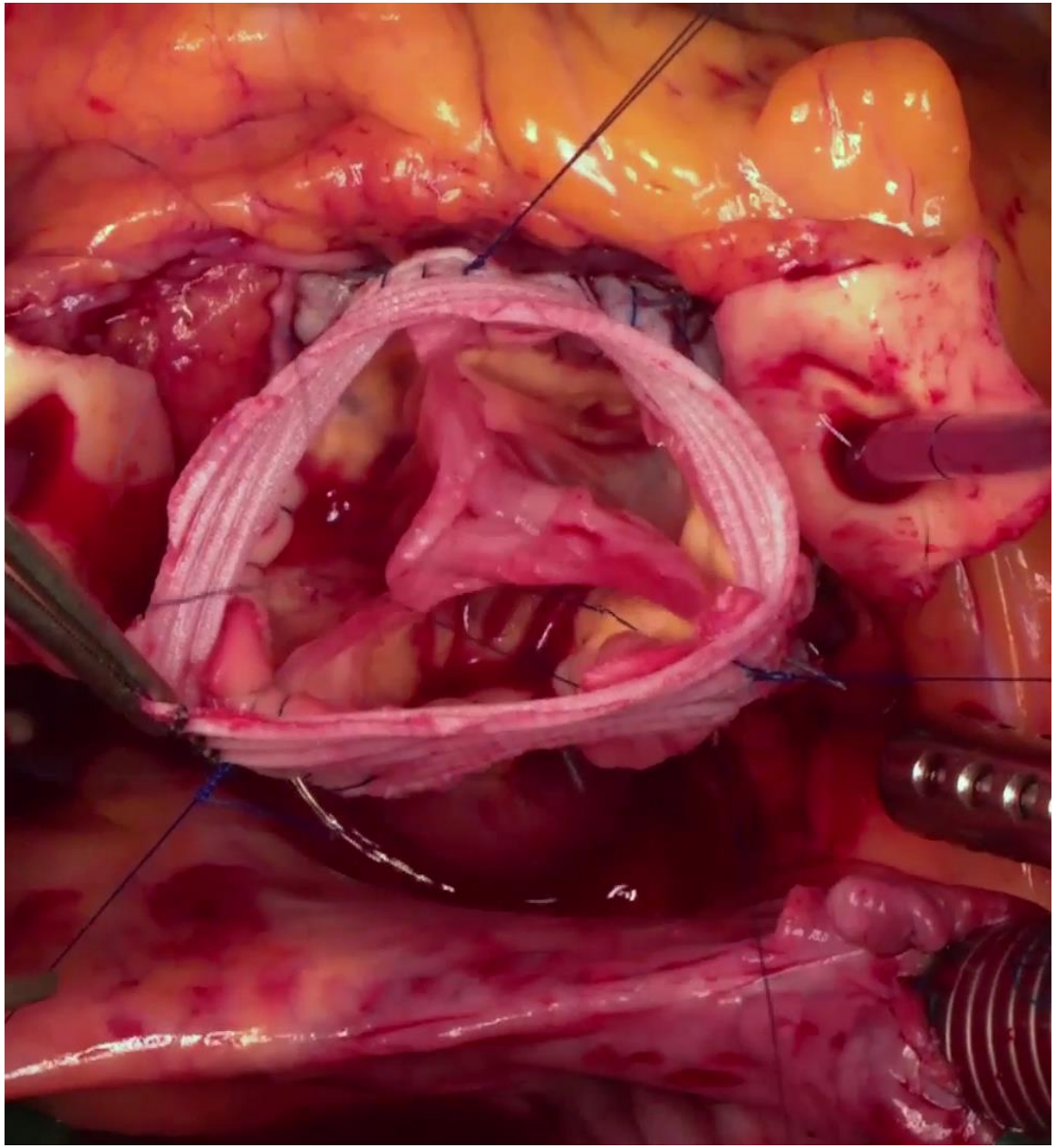
3. Complex cusp repair
4. Graft sizing & proximal suture line
5. **Com. attachment & distal suture line**
6. Residual prolapse repair
7. Coronary reimplantation



VSRR: How to do it ? Brussels Technique

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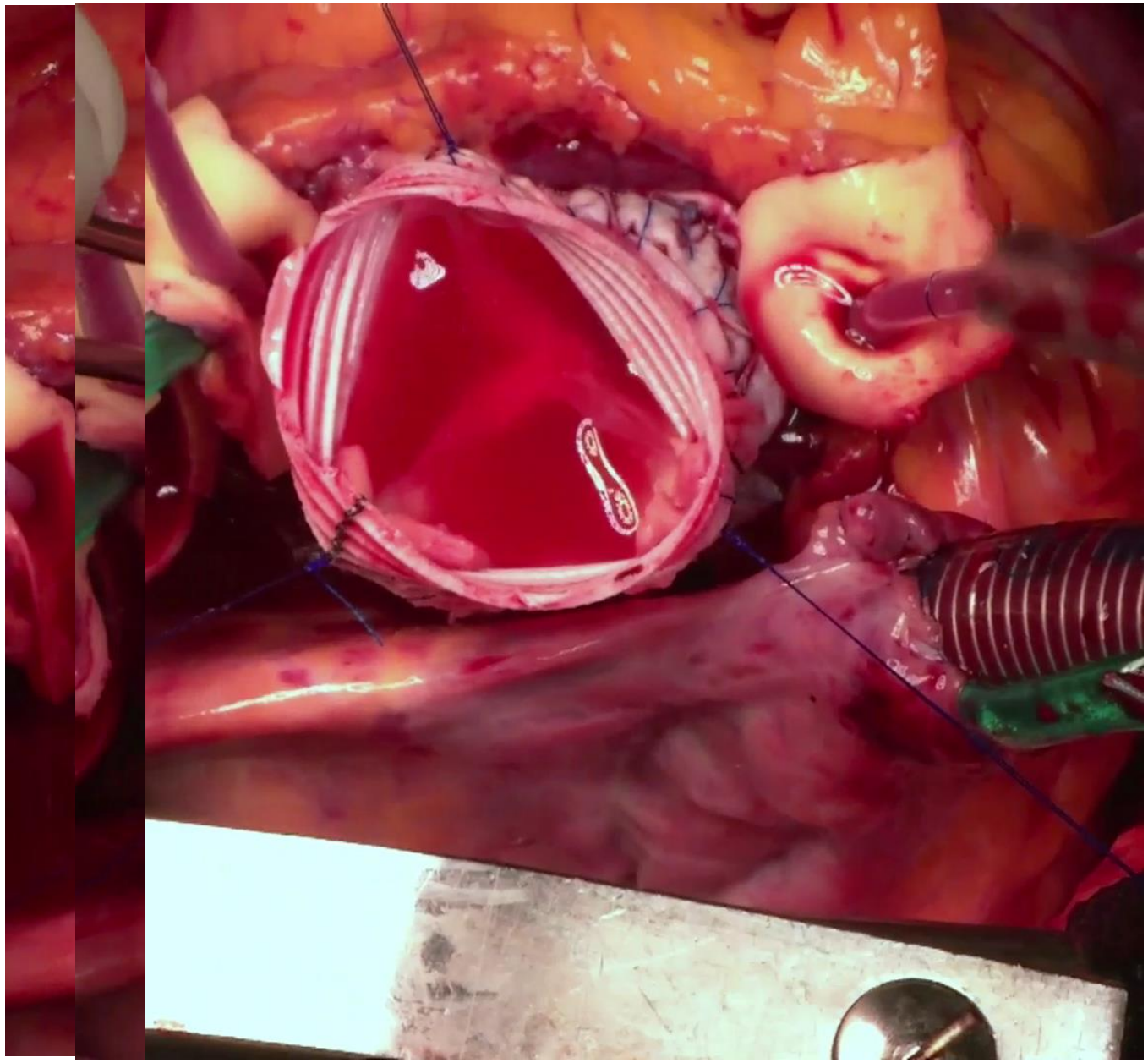
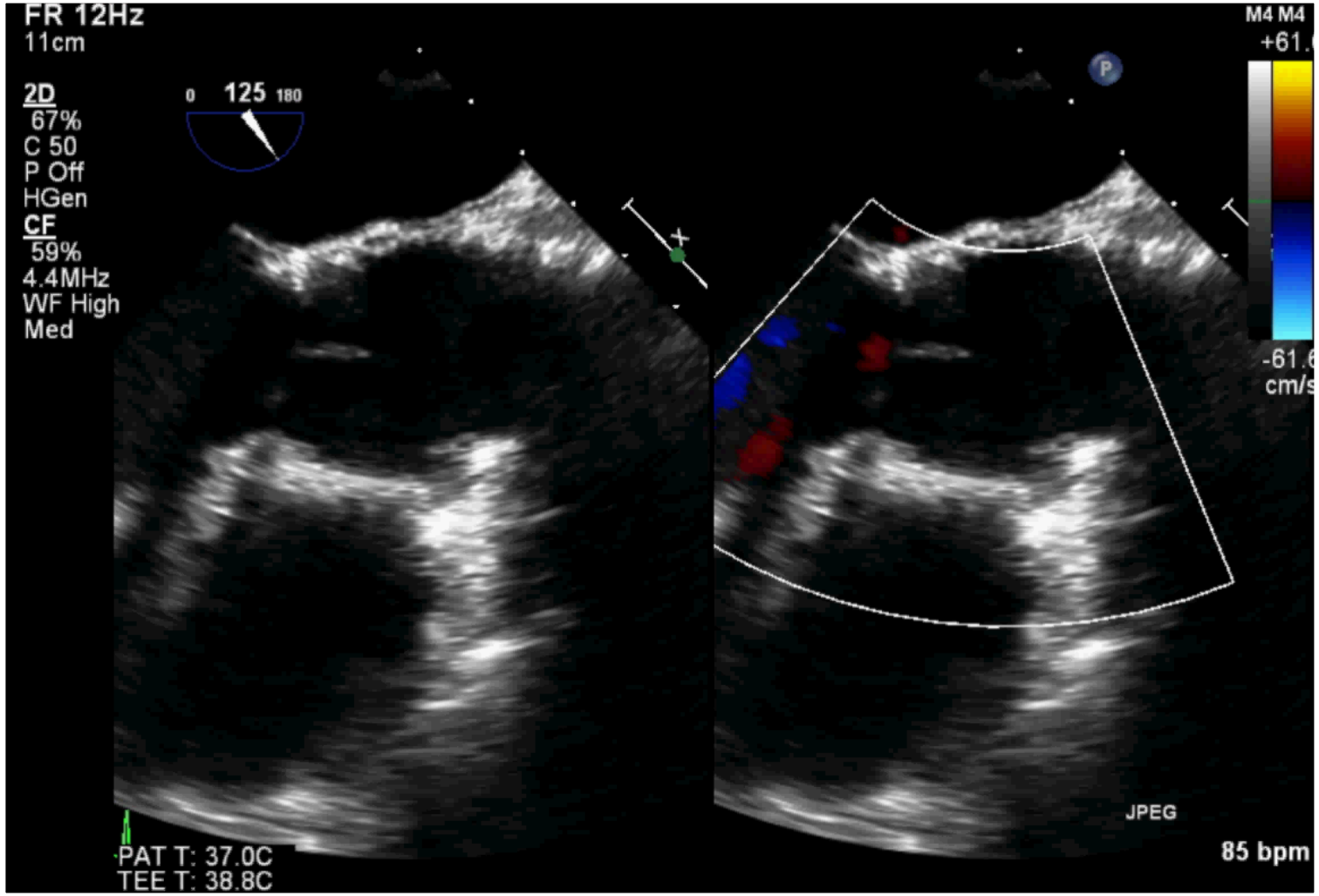


VSRR: How to do it ? Brussels Technique

Post-repair TEE



VSRR: Why and How to do it ?

Conclusions

- VSRR is SAFE, DURABLE, EXC. LT. SURVIVAL & FEW VRE (< Bentall)

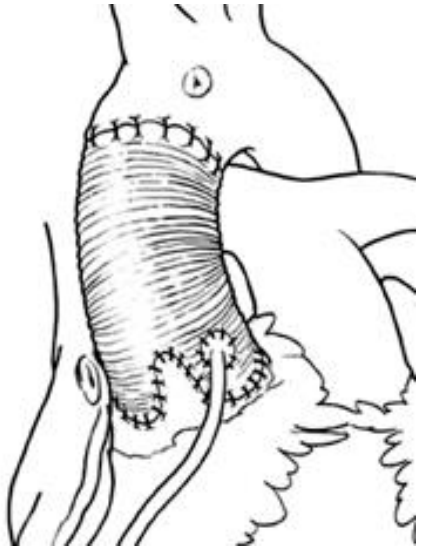
in TAV, BAV but also Marfan and AAD

with *Reimplantation* and with *Remodeling* techniques

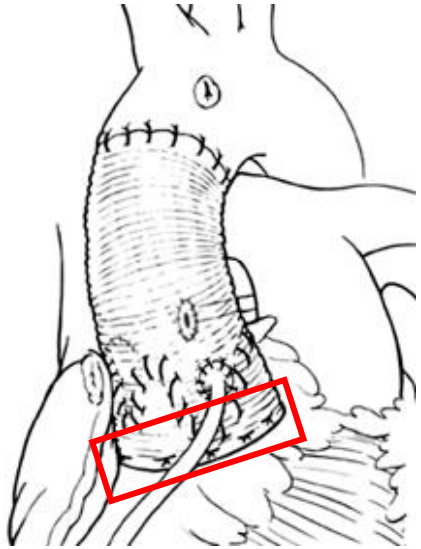
Condicio sine qua non
ANNULOPLASTY & CUSP REPAIR !

VSRR: The Litterature

Remodeling



Reimplantation



- *Birks EJ., Yacoub MH. Circulation. 1999*
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Suggest better repair durability with the Reimplantation technique

AV Repair:
Leaflet repair in valve sparing surgery

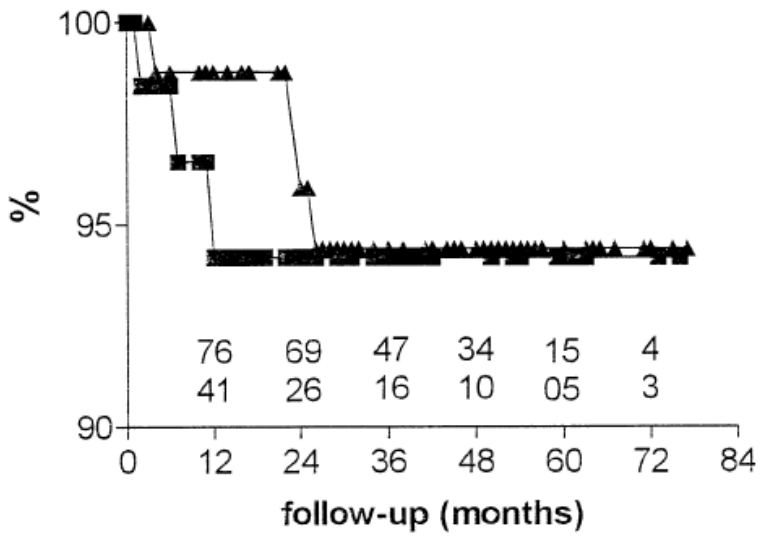
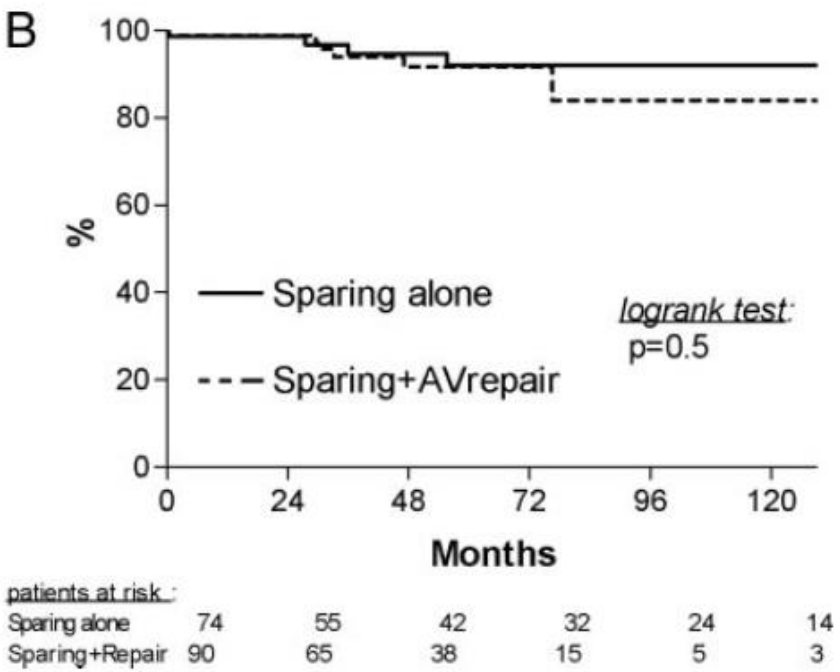


Fig 1. Actuarial freedom from aortic regurgitation greater than II after valve-preserving aortic replacement in patients with intact leaflets (triangles) or leaflet prolapse requiring correction (squares).

H.J. Schäfers ATS 2002

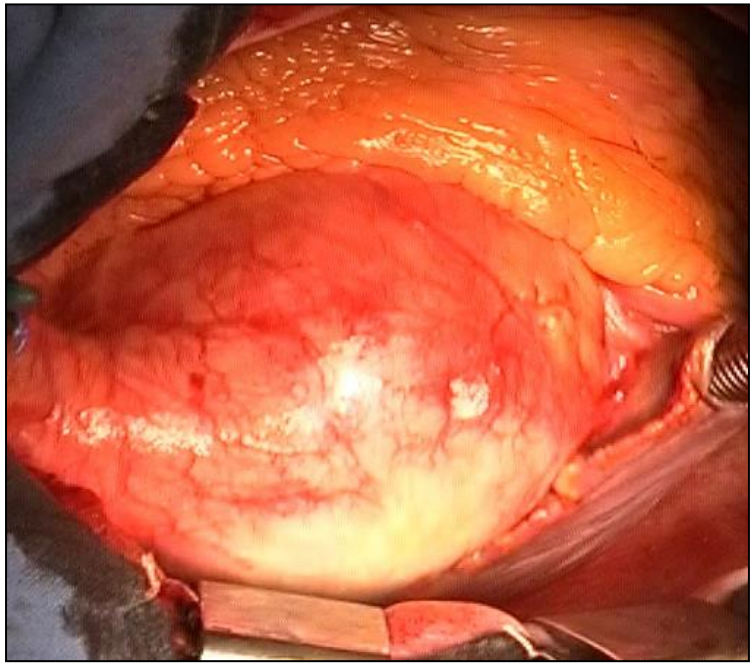


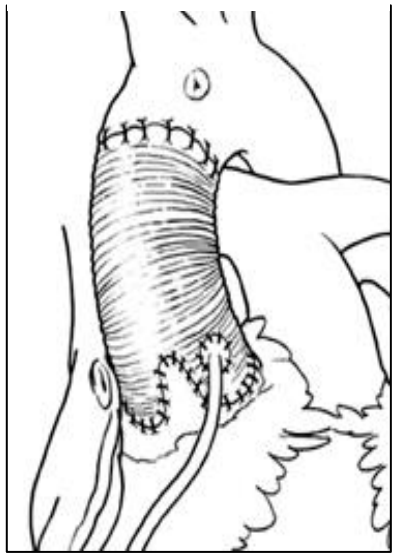
L. de Kerchove Circ. 2009

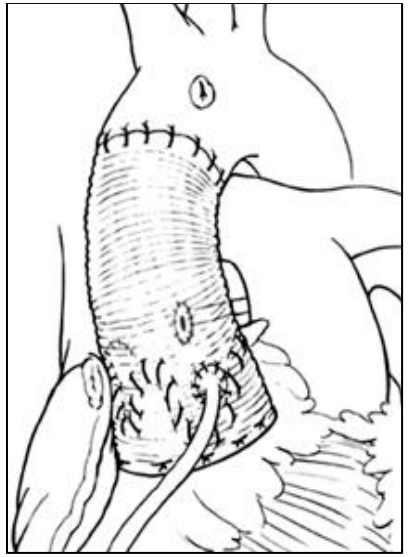
Cusp repair = risk factor of reoperation or recurrent AR

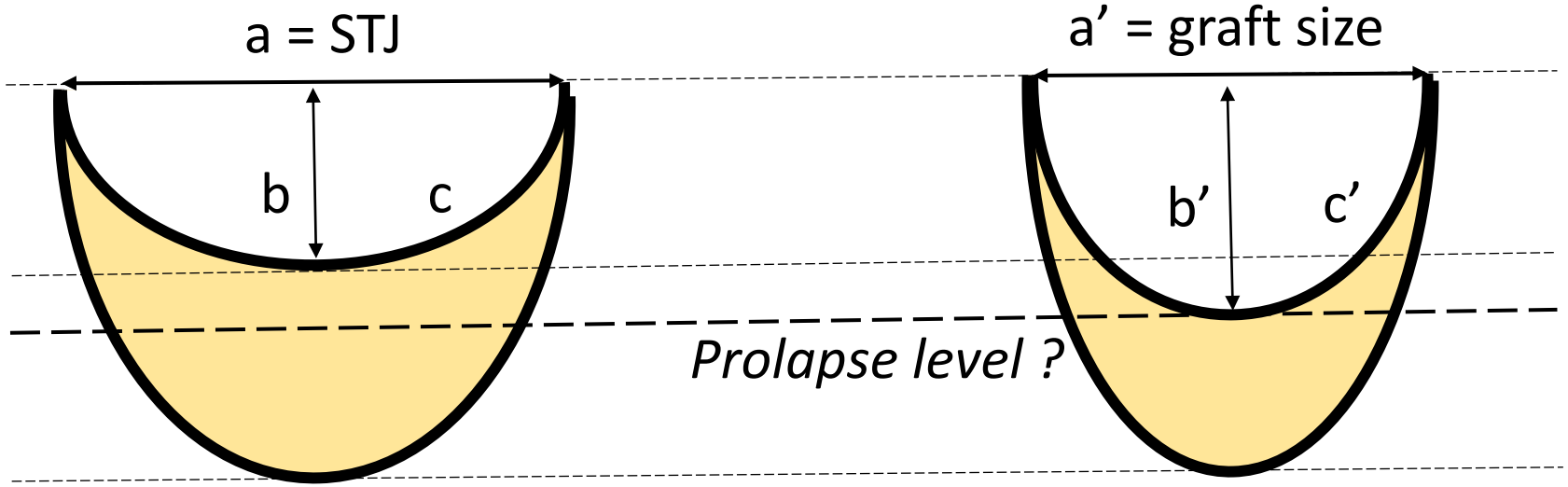
- *E. Lansac EJCTS 2010 (negative impact of cusp repair decrease with experience)*
- *P.P. Urbanski EJCTS 2012*

Valve sparing root replacement









VSRR: Why to do it?

Hospital mortality

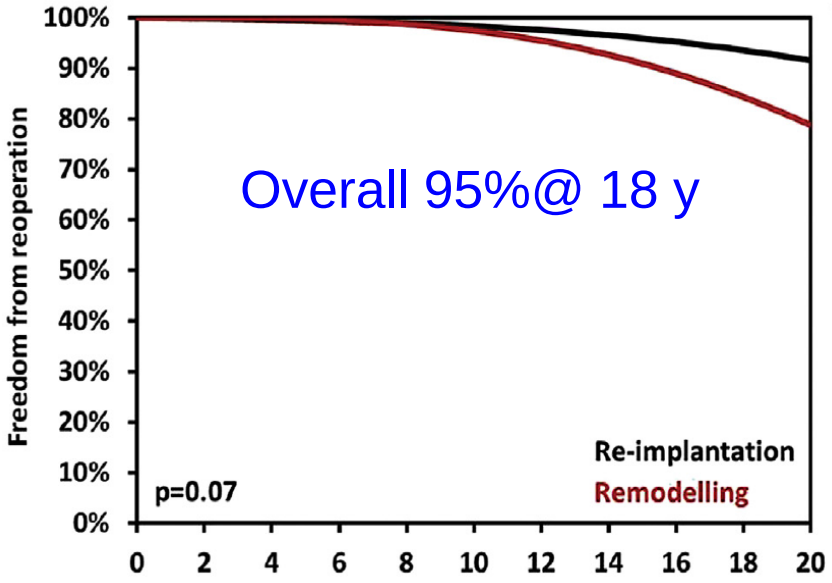
12% AAD •	1%	(4/371 pts Reimpl. & Remod.)	T. David JTCVS 2014
8% AAD •	2%	(6/747 pts Remodeling)	H-J Schäfers EJCTS 2015
10% AAD •	2%	(4777 pts Metanalysis)	*B. Arabkhani ATS 2015*
Elective •	0.3%	(1/381 pts Reimplantation)	G. El khoury, updated series 2000 – 2015
6% AAD •	0.7%	(1/146 Marfan Reimpl.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

1. SAFE !

VSRR: Why to do it?

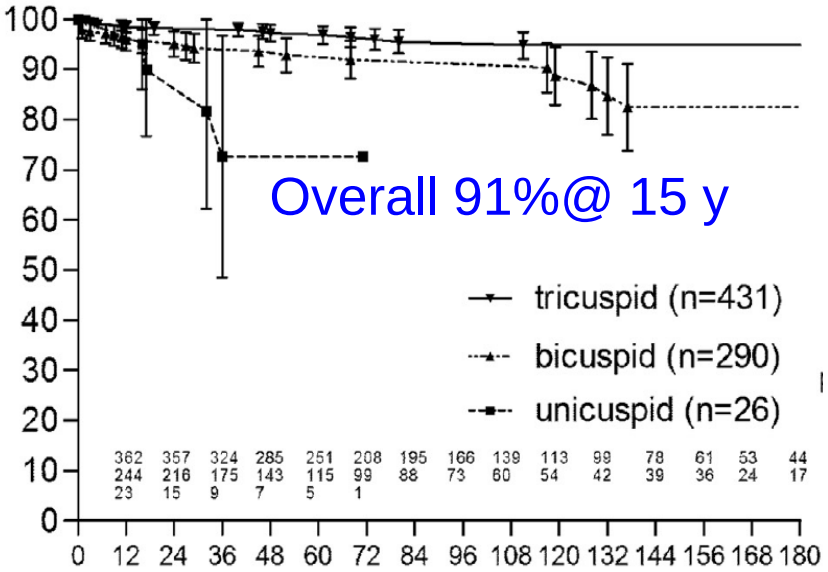
Freedom from Reoperation

Reimpl. & Remod.



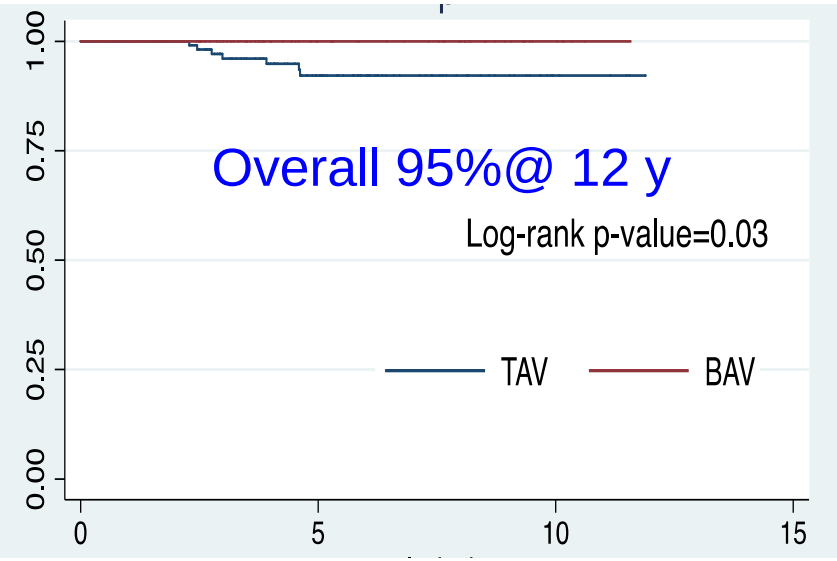
T. David JTCVS 2014

Remodeling



H-J Schafers EJCTS 2015

Reimplantation



S. Mastrobuoni STSA 2014

2. Durable !

VSRR: Why to do it rather than Bentall?

VSRR

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

Bentall

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

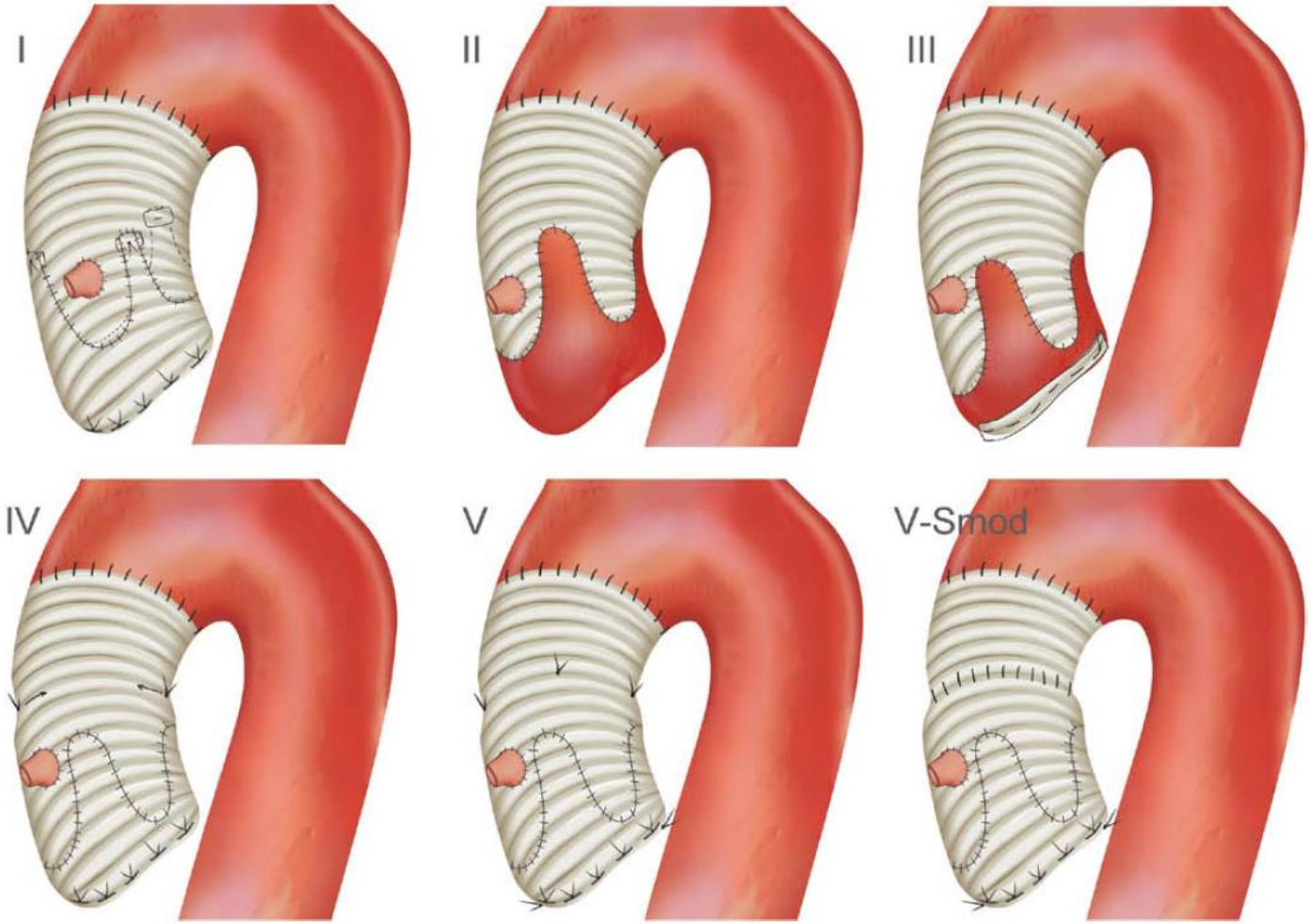
3. Exc. LT. Survival!

4. Few VRE!

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

VSRR: How to do it ?

David Operations

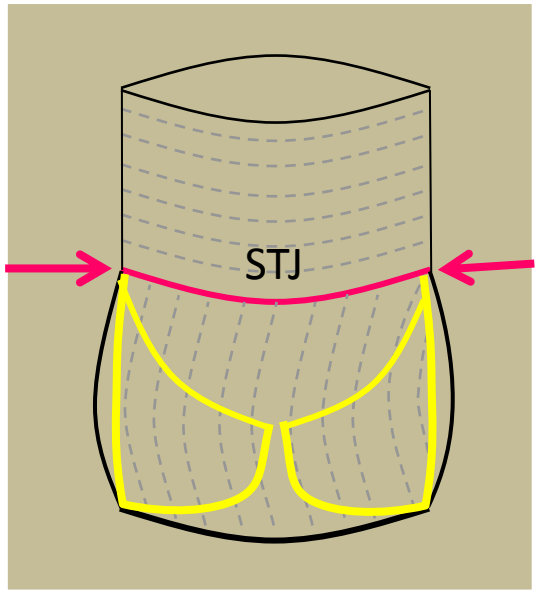


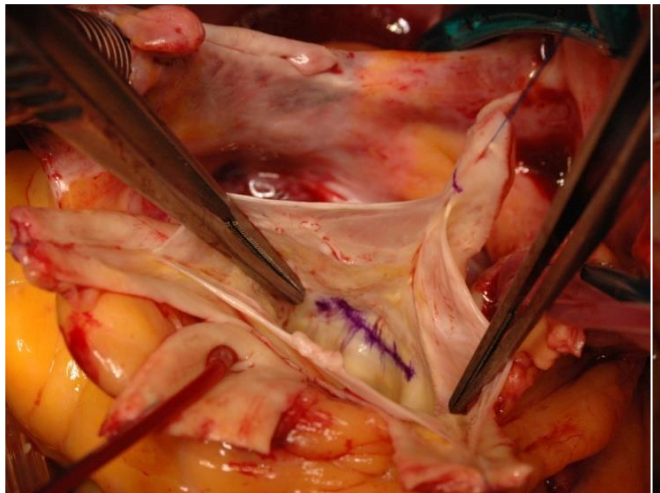
Kari F.A. Circ 2013

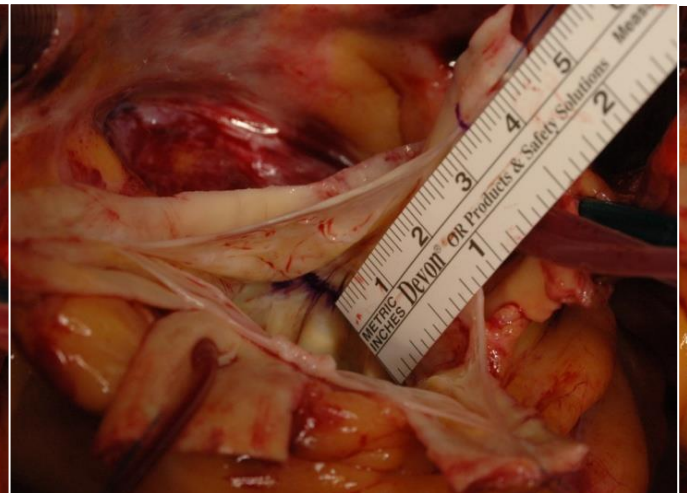
VSRR: How to do it ? Brussels Way

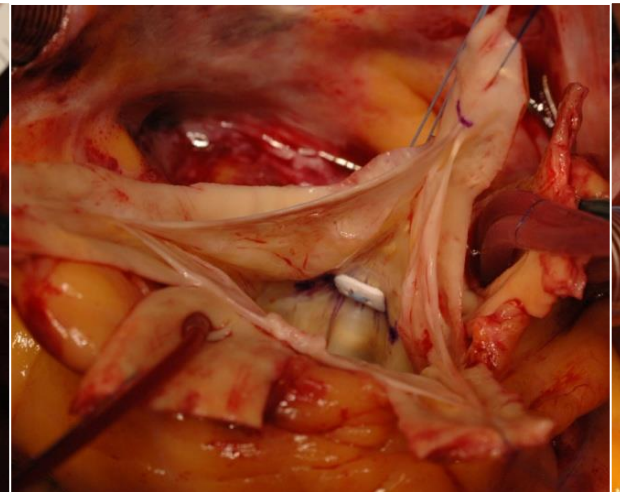
Graft Sizing: *N/L com height* method

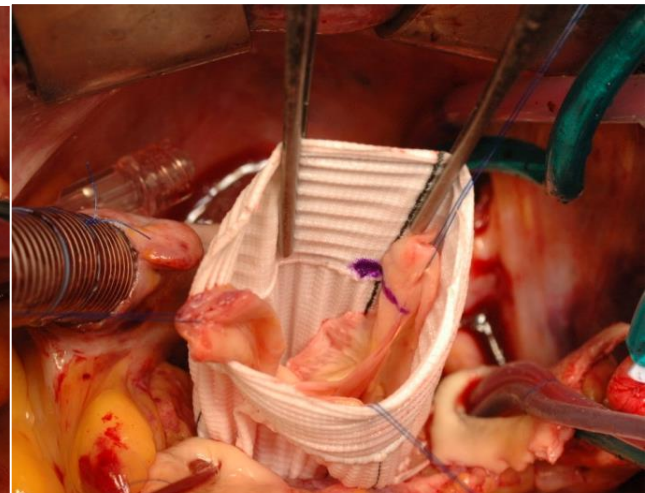
=







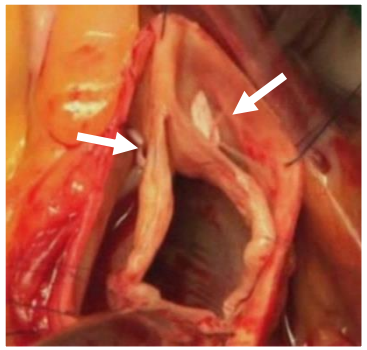


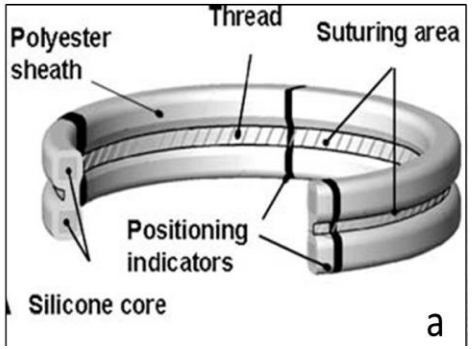


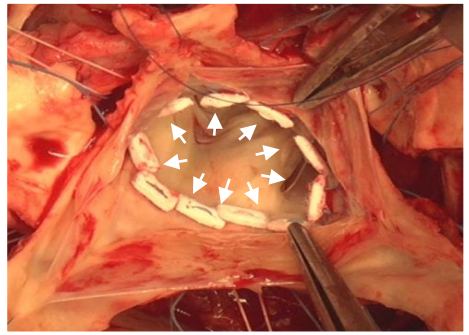
AV repair
Aorta/Annuloplasty repair strategy

AV repair for AR

- Normal Root (<45 mm)
  - Normal VAJ (<26 mm) → Subcom. Anpl.
  - Large VAJ (>26 mm) → Ring Annuloplasty
  - Large VAJ (>26 mm) + Modify valve geometry → VS Reimplantation
- Dilated Root (≥45 mm) → VS Reimplantation

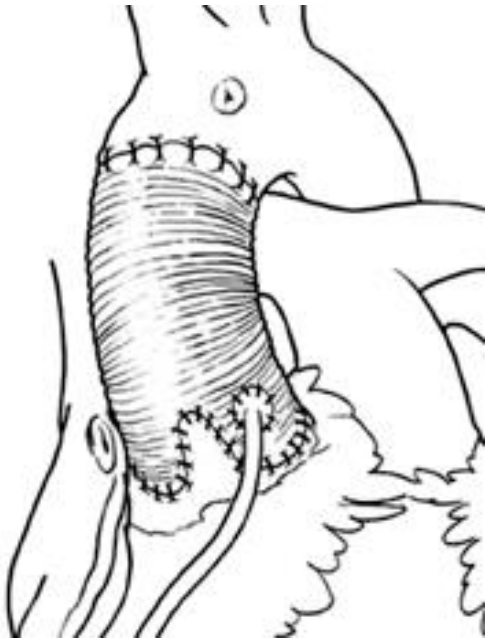




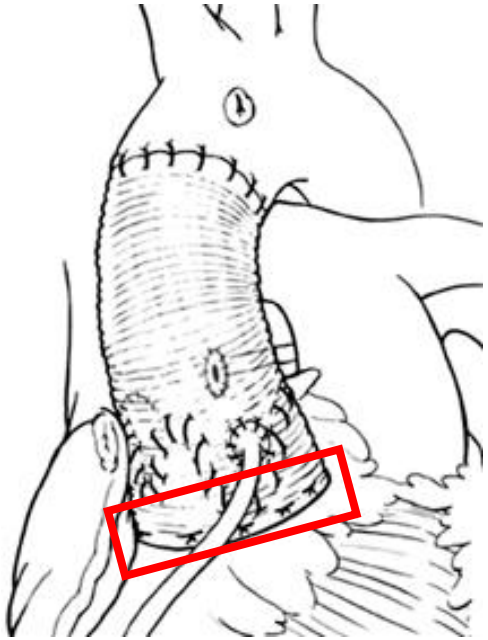


VSRR: How to do it?

Remodeling



Reimplantation



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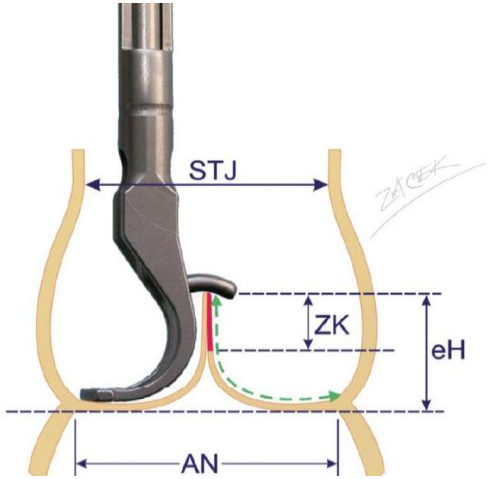
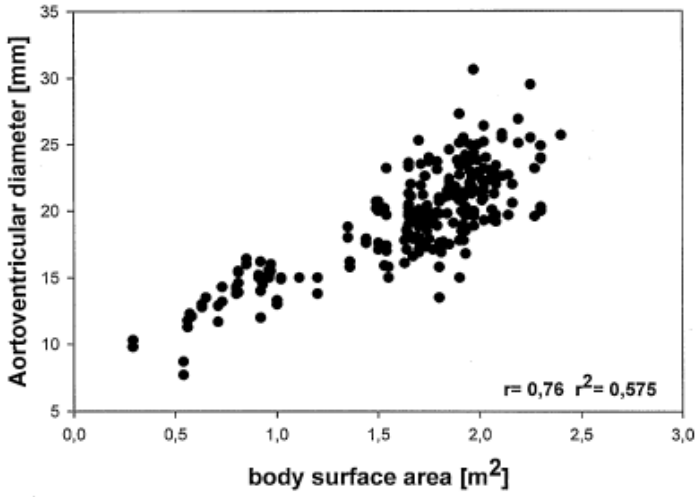
Suggest better repair durability with the Reimplantation technique

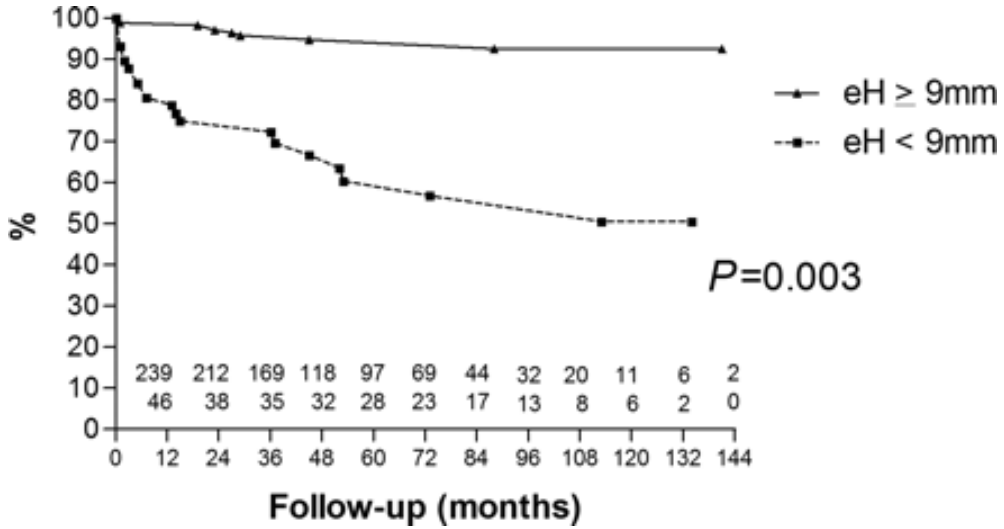
Predictors of AR recurrence

Coaptation height





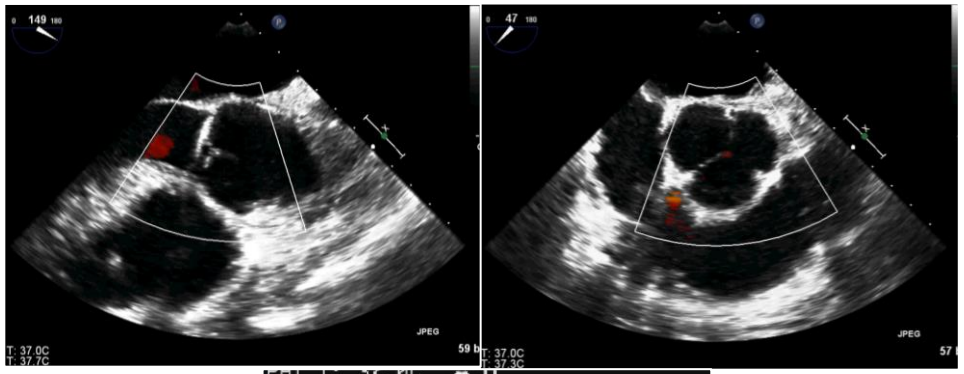
Bierbach B.O. EJTCS 2010



Aicher D. Circulation ;123:178-85, 2011

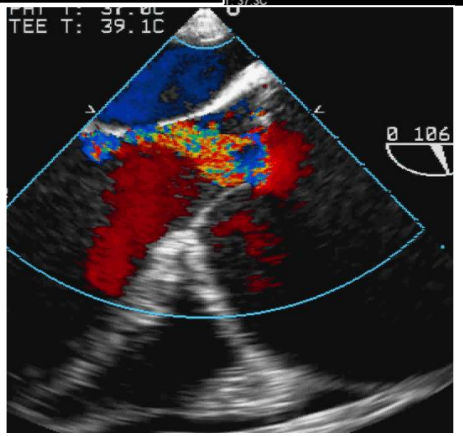
AV repair:
Probability of Cusp Repair in valve sparing surgery

- **No AR**



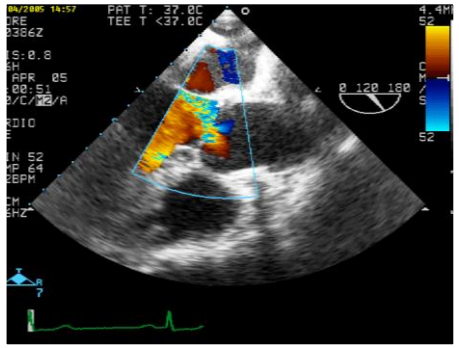
→ low 10 %

- **AR, central jet**



→ Moderate 30-50 %

- **AR, eccentric jet**

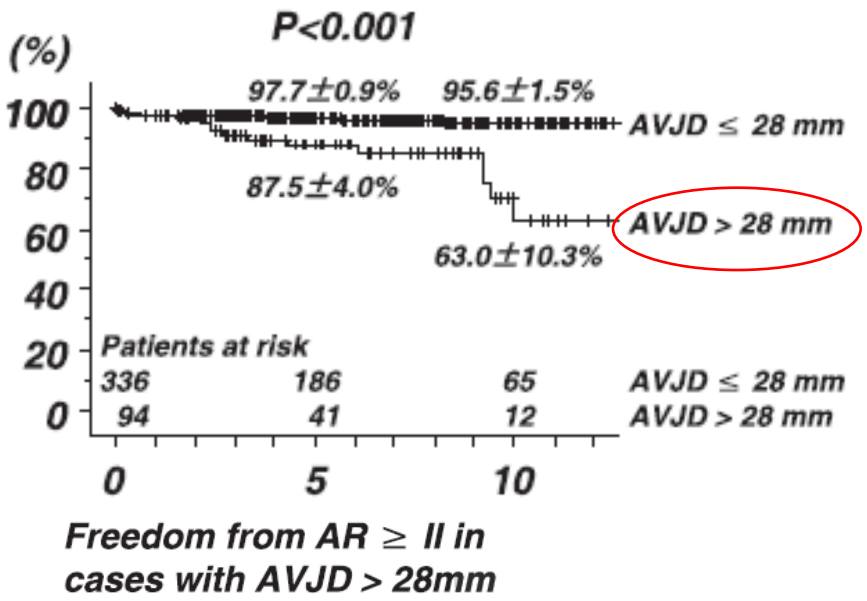


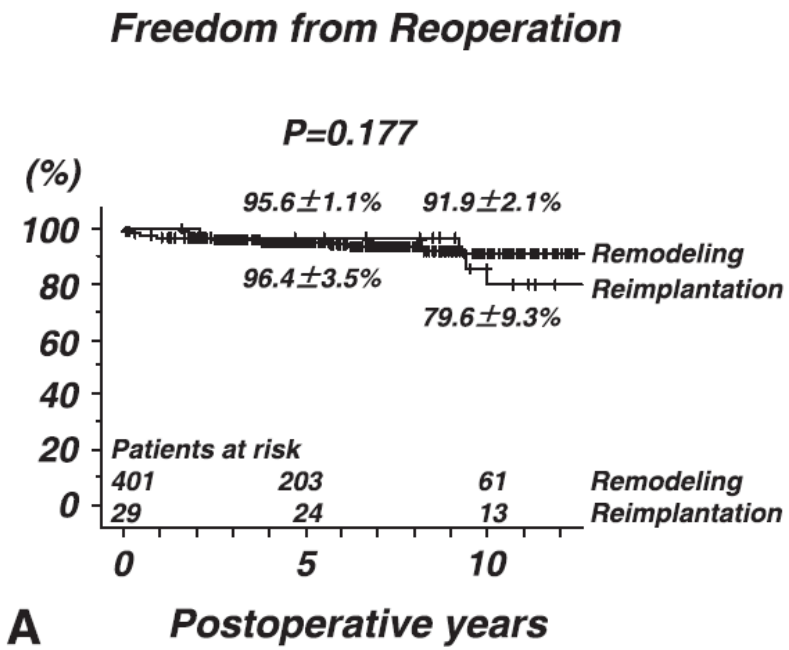
→ High ≈ 100 %

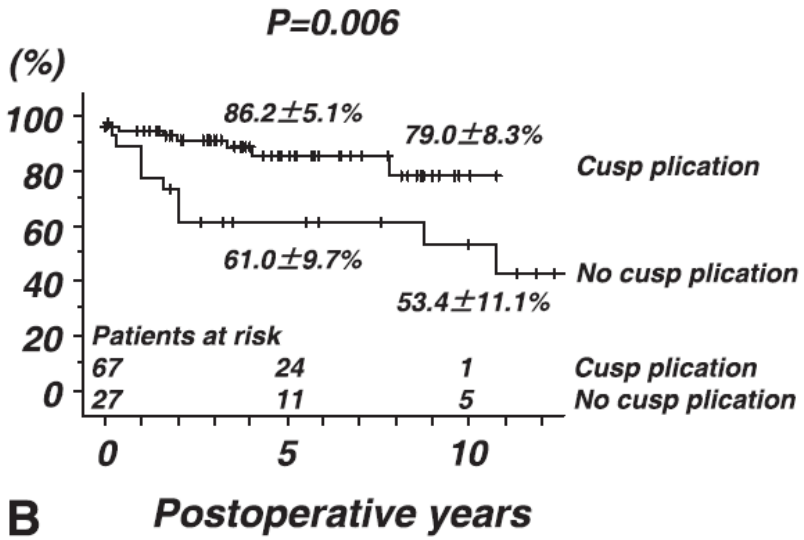
Effect of VAJ size on AV repair durability

✓ *Kunihara T., Schäfers H.J. JTCS 2012:*

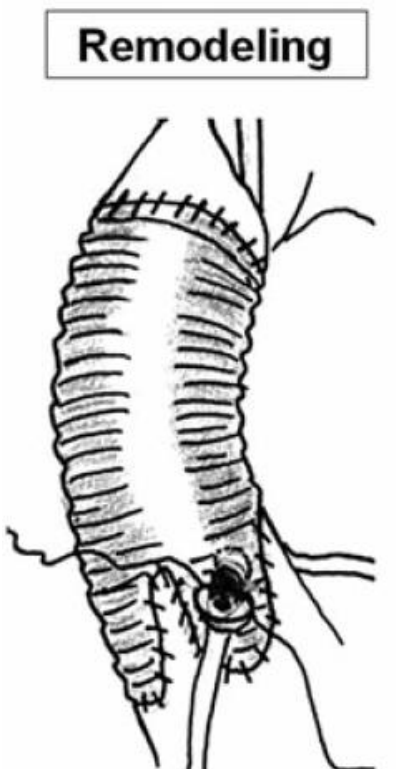
- 430 VSRR, 70% TAV,
- 93% remodeling

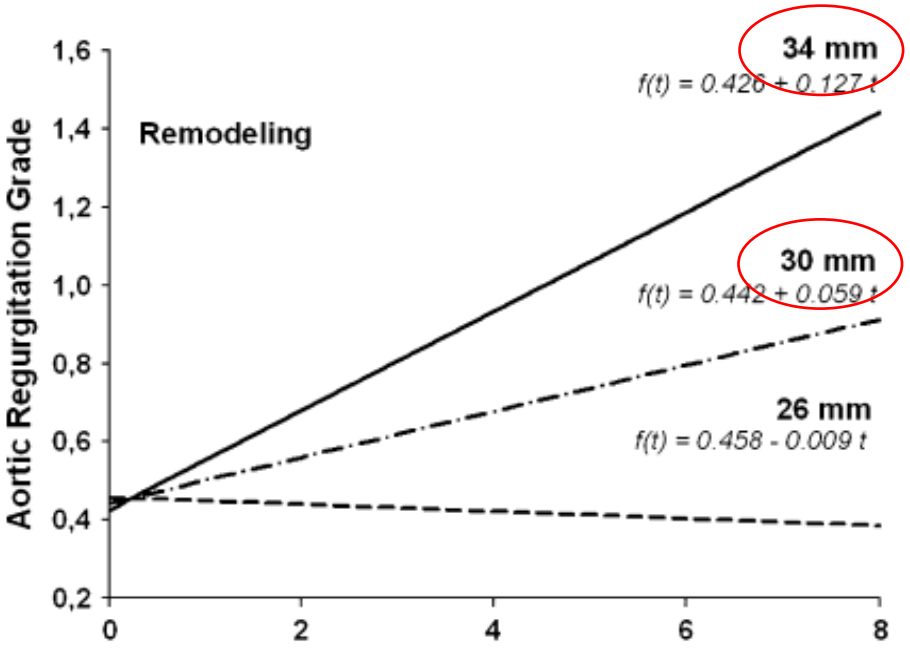


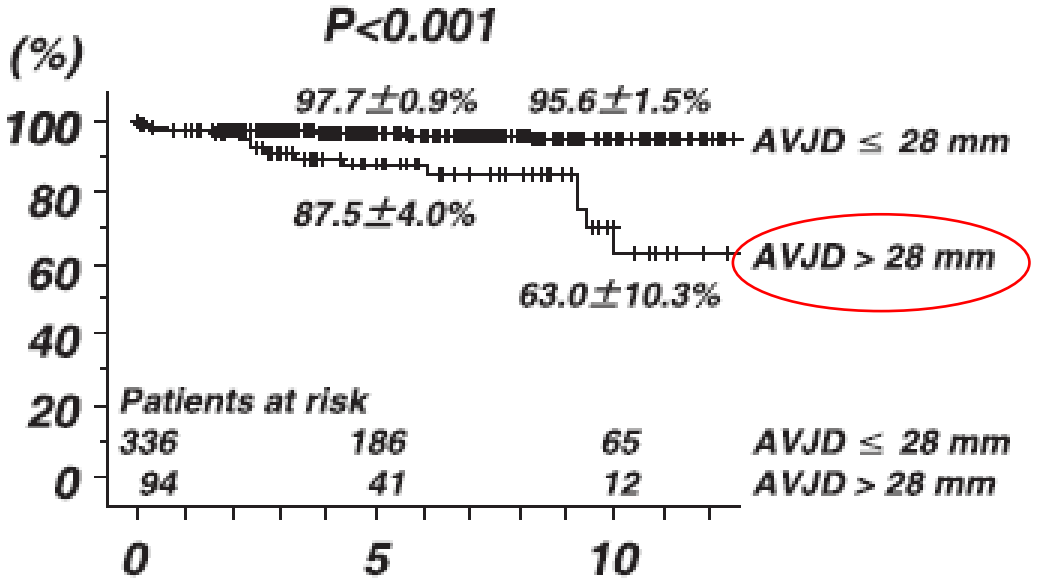




VSRR: How to do it ?

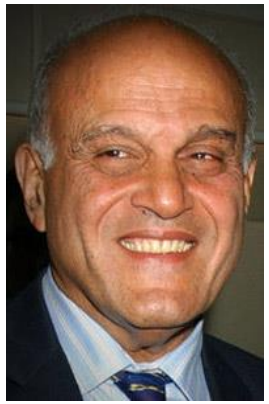




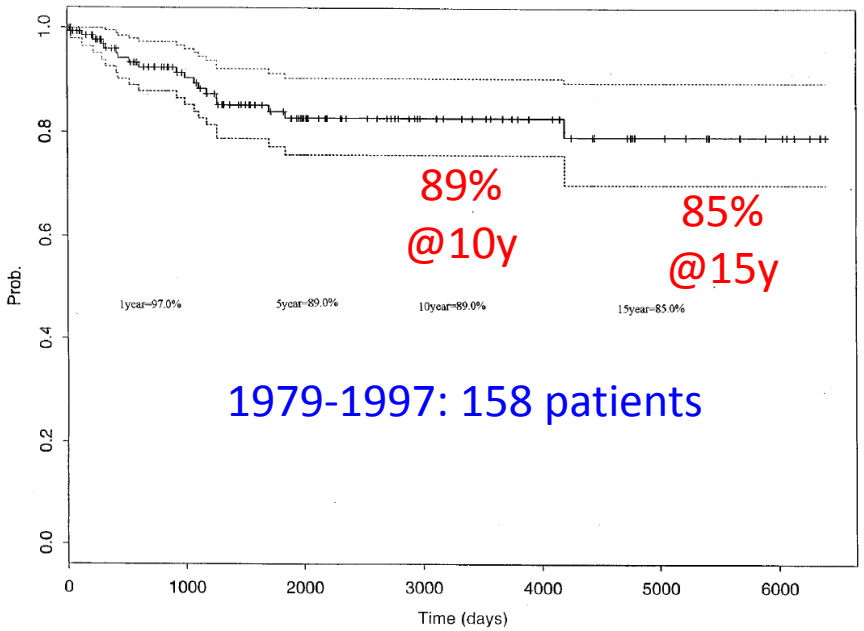


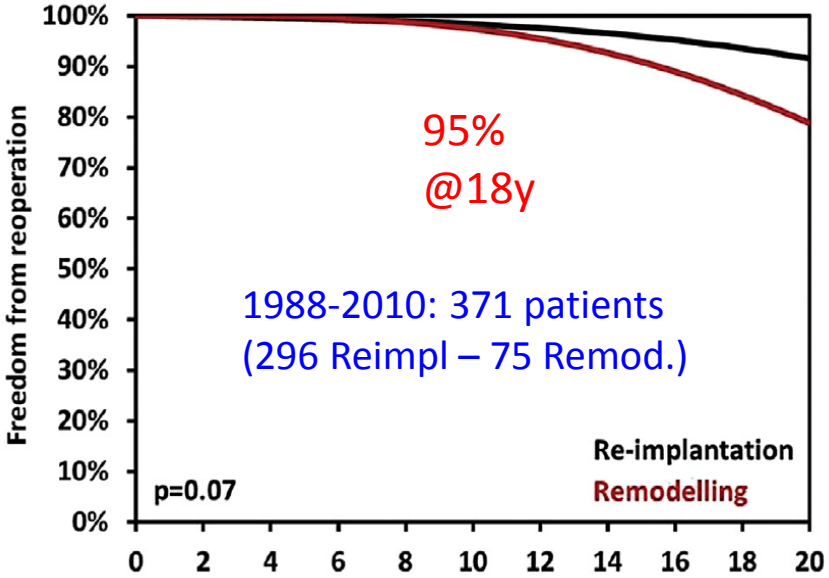
Hanke T. JTCVS 2009
Kunihara T. JTCVS 2012

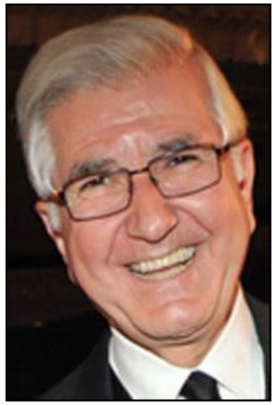
VSRR: Outcomes of historical cohort



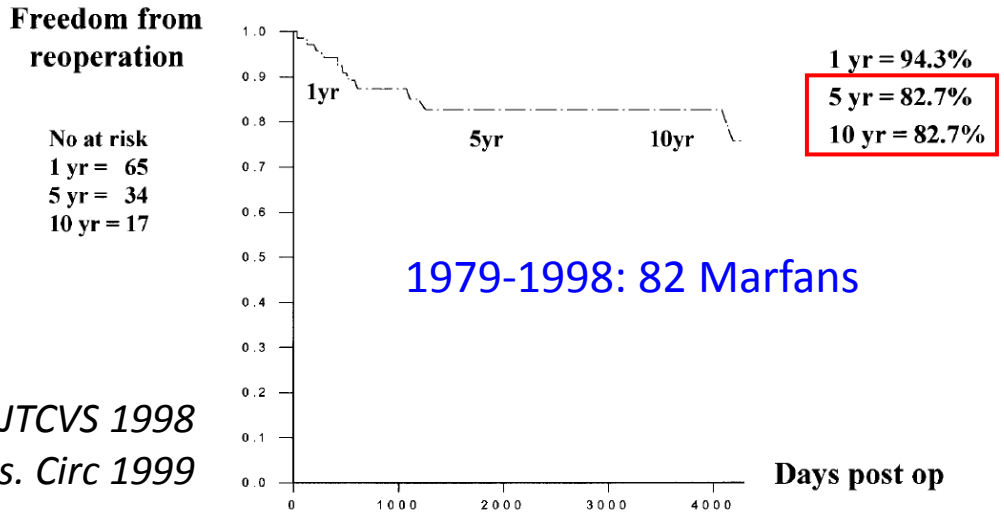
Sir M. Yacoub

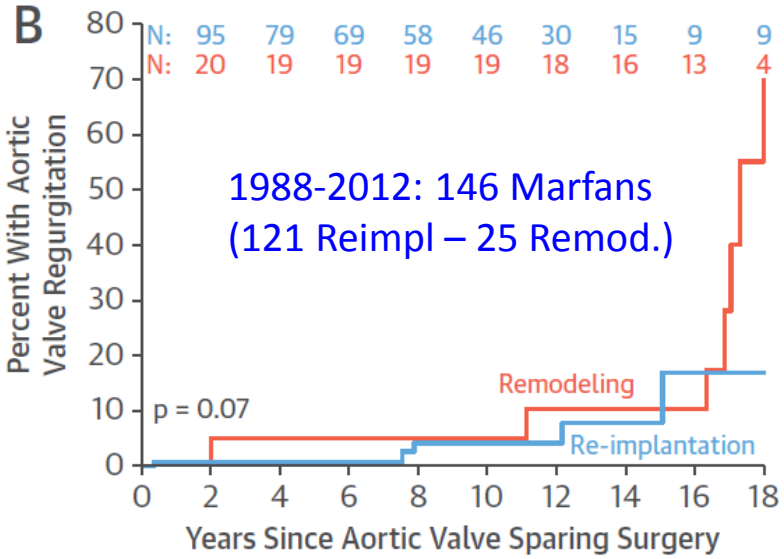






T. David



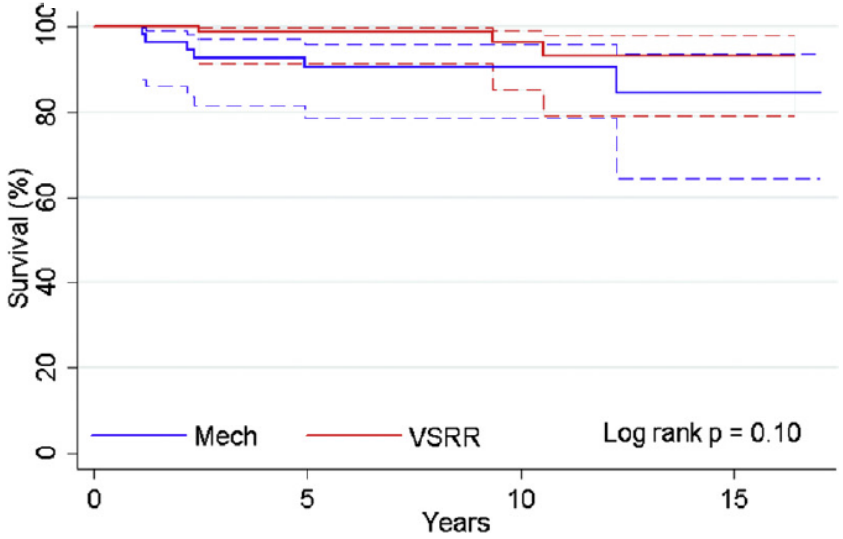


M.H. Yacoub JTCVS 1998
E.J. Birks. Circ 1999

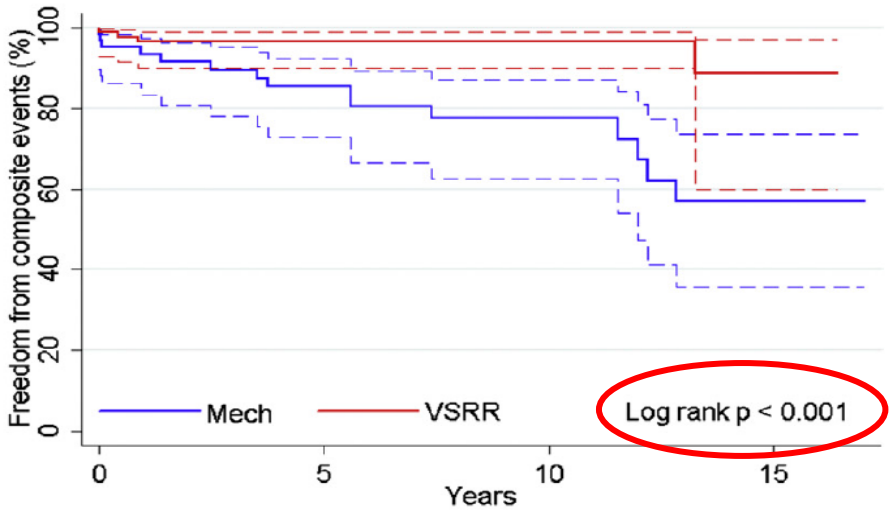
T. David JTCVS 2014
T. David JACC 2016

VSRR: Why to do it in Marfan syndrome ?

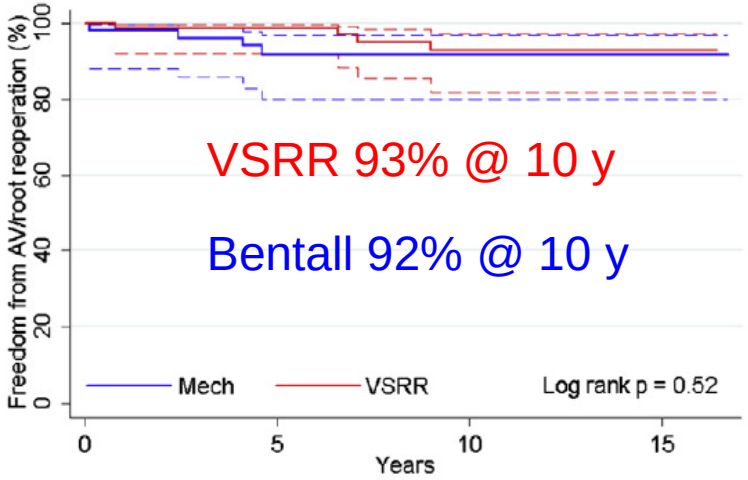
Survival

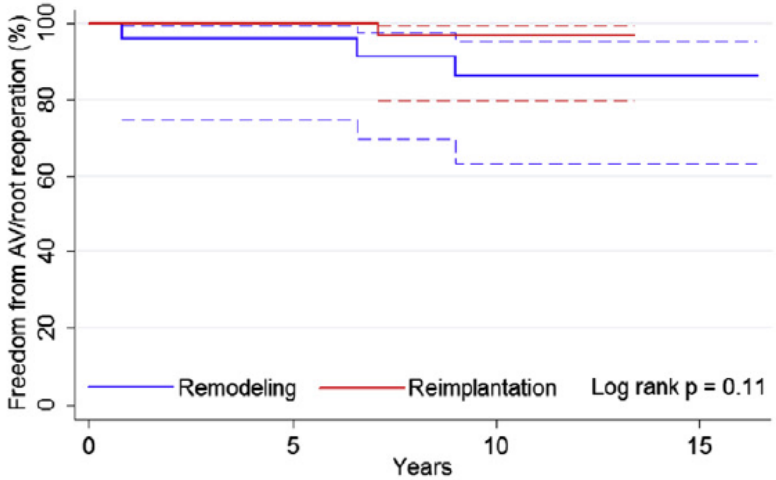


Freedom from TE/Bleeding event



Freedom from Reoperation

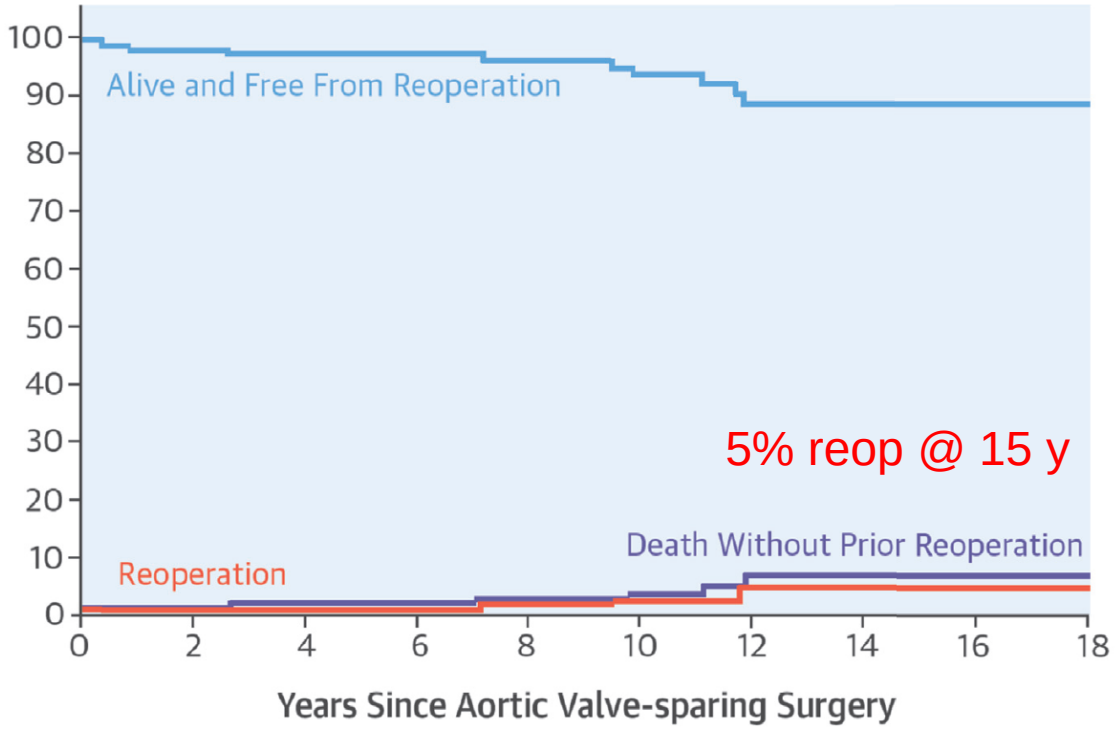




J. Price JTCVS 2016

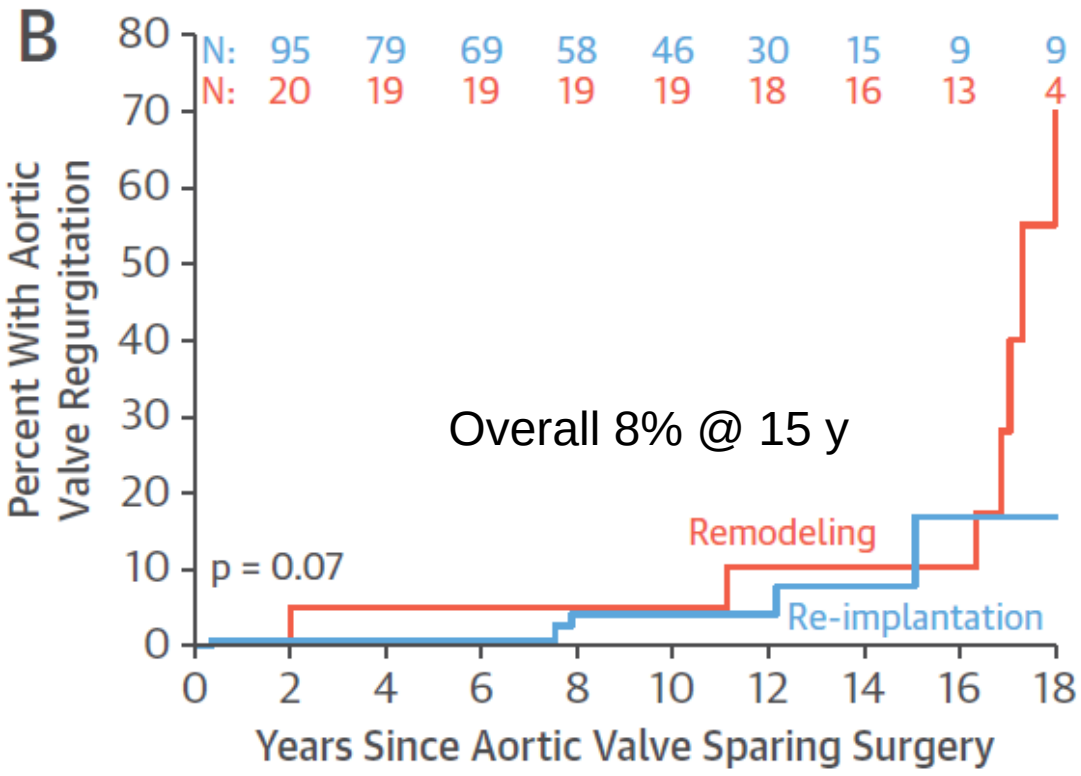
VSRR: Why to do it in Marfan syndrome ?

Freedom from Reoperation



N:	125	106	94	84	72	50	35	22	14

Freedom from AI >2+



T. David JACC 2015

VSRR: Remodeling+annuloplasty long term result

✓ *Lansac E., EJCTS 2006:*

- 87 pts, 95% TAV
- 100% Remodeling, 60% with ring annuloplasty
- Less early residual or recurrent AI in Remodeling + ring group

✓ *Aicher D., JTCS 20013:*

- 559 BAV repair
- 193 (34%) VAJ suture annuloplasty in patient VAJ >27 mm
- Less early residual or recurrent AI in annuloplasty group