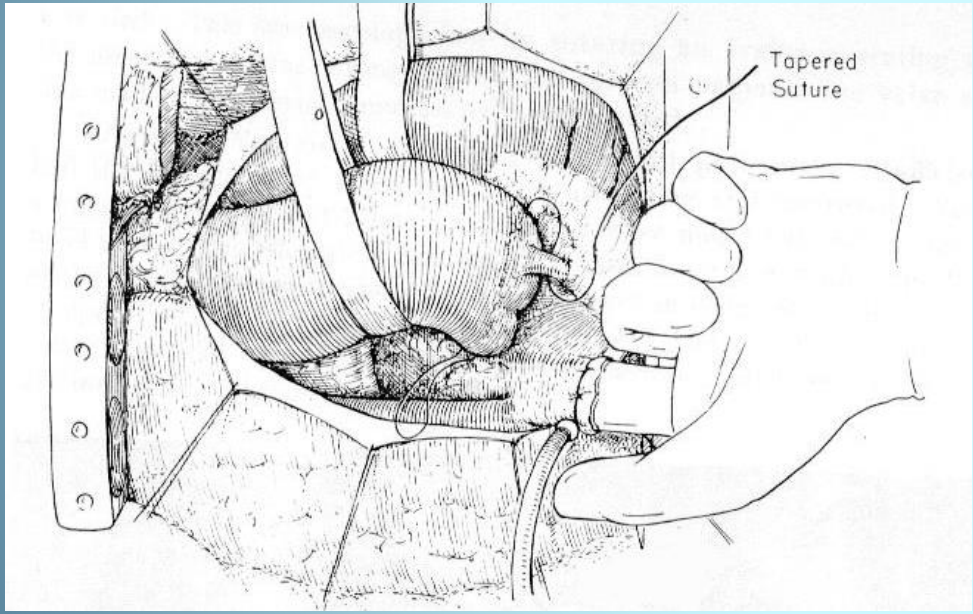
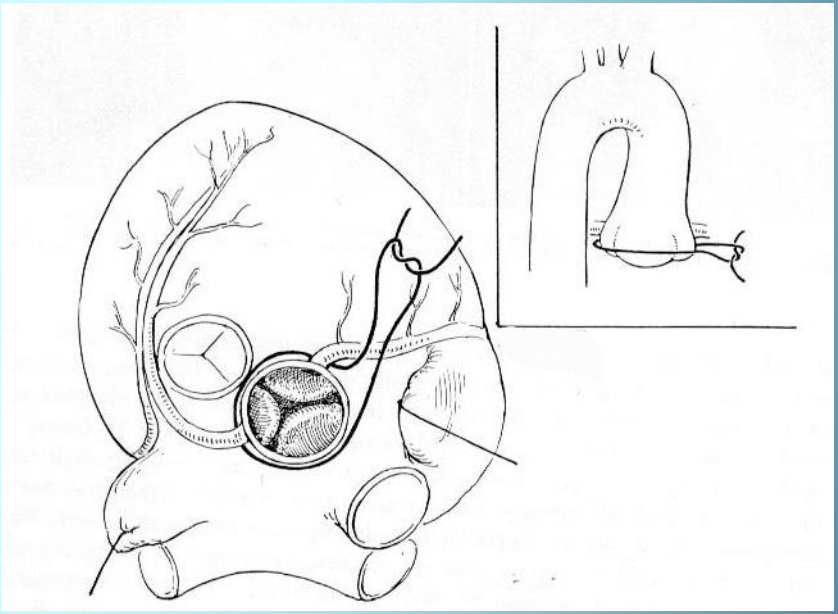
Annuloplasty – The Evidence

Ulrich Schneider
Department of Thoracic and Cardiovascular Surgery
Saarland University Medical Center
Homburg/Saar, Germany

Historical Background

"The surgical correction of aortic insufficiency by circumclusion"

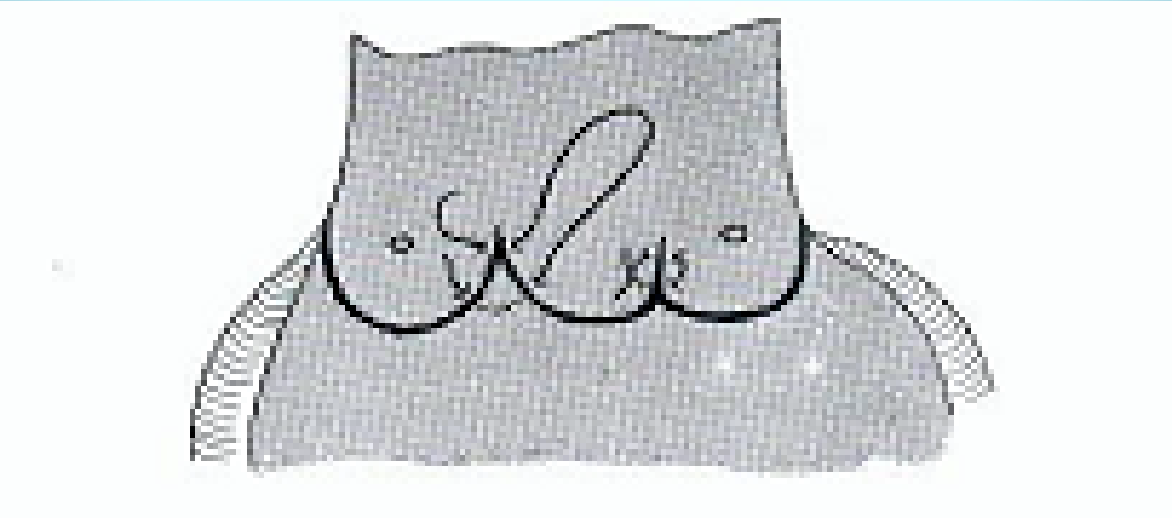




Taylor et al., J Thorac Surg 1958

Historical Background

Subcommissural Plication



Cabrol et al., Arch Mal Coeur Vaiss 1966

The Aortic Annulus

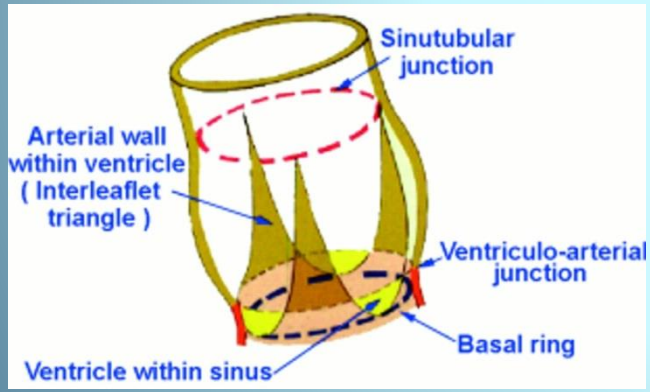
ANATOMY

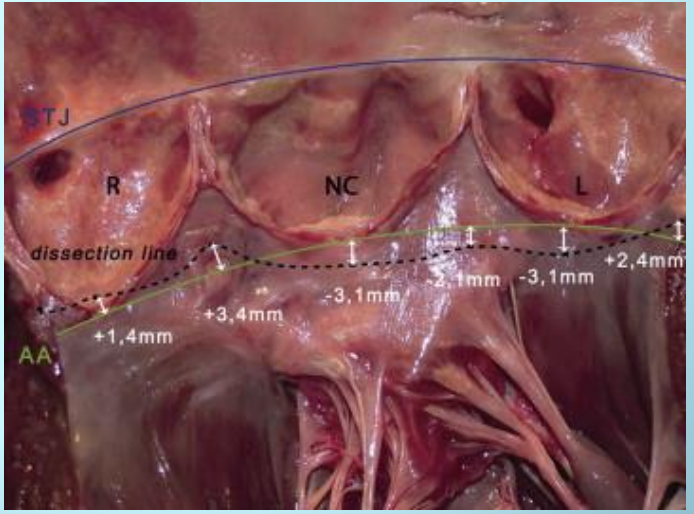
Clinical anatomy of the aortic root

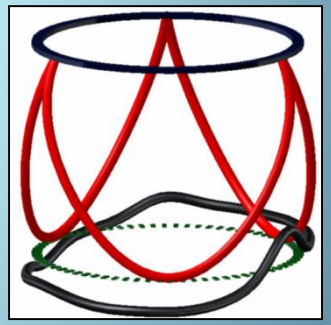
Robert H Anderson
Cardiac Unit, Institute of Child Health,
University College London, UK

Surgical Anatomy of the Aortic Annulus: Landmarks for External Annuloplasty in Aortic Valve Repair

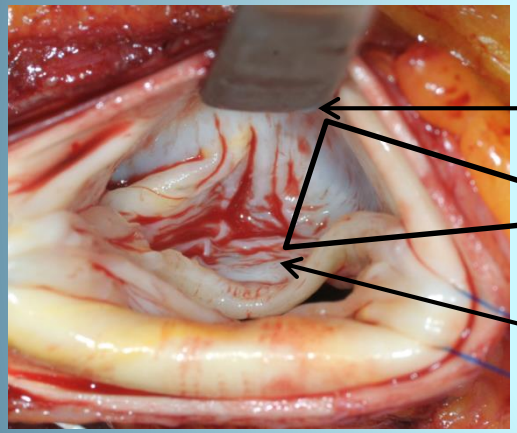
Nizar Khelil, MD, Ghassan Sleilaty, MD, Michele Palladino, MD, Mahmoud Fouda, MD, Remi Escande, MD, Mathieu Debauchez, MD, Isabelle Di Centa, MD, and Emmanuel Lansac, MD, PhD



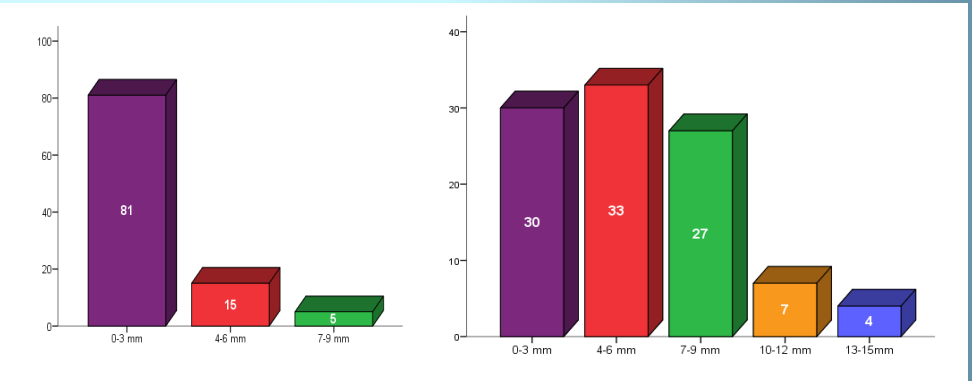




Aortic Annulus ↔ Basal Ring



Morphometric study (BAV)



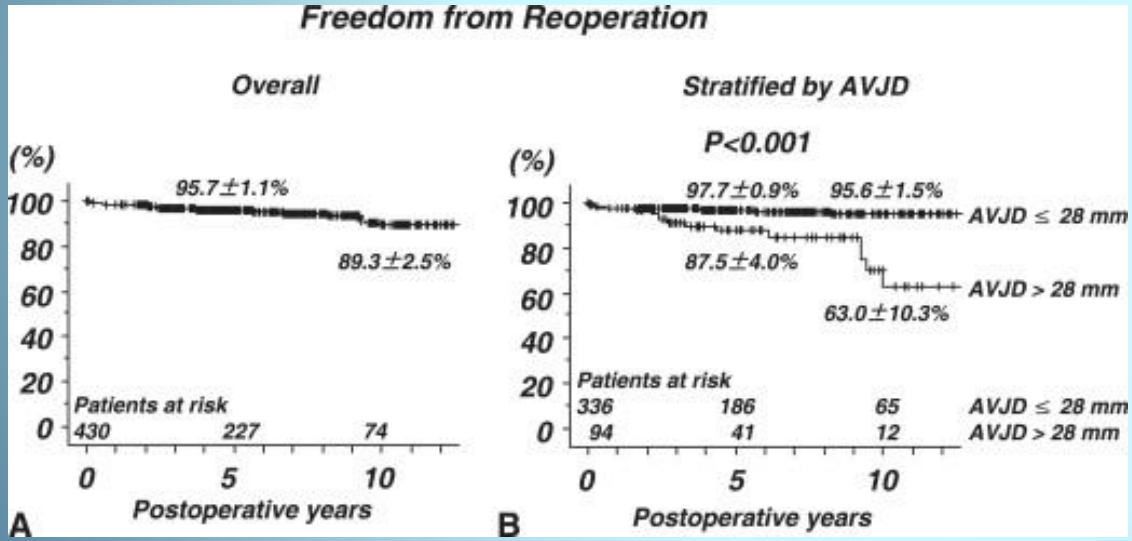
left sinus

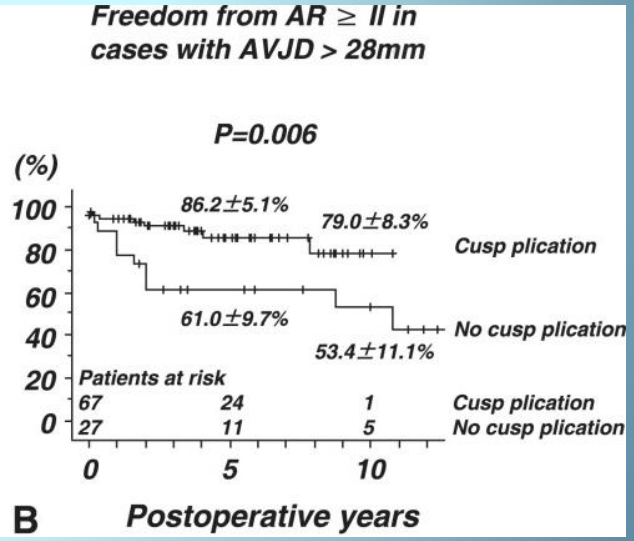
right sinus

Do we need an annuloplasty?

Preoperative aortic root geometry and postoperative cusp configuration primarily determine long-term outcome after valve-preserving aortic root repair

Takashi Kunihara, MD, PhD,[a] Diana Aicher, MD,[a] Svetlana Rodionycheva, MD,[a] Heinrich-Volker Groesdonk, MD,[a] Frank Langer, MD,[a] Fumihiro Sata, MD, PhD,[b] and Hans-Joachim Schäfers, MD, PhD[a]

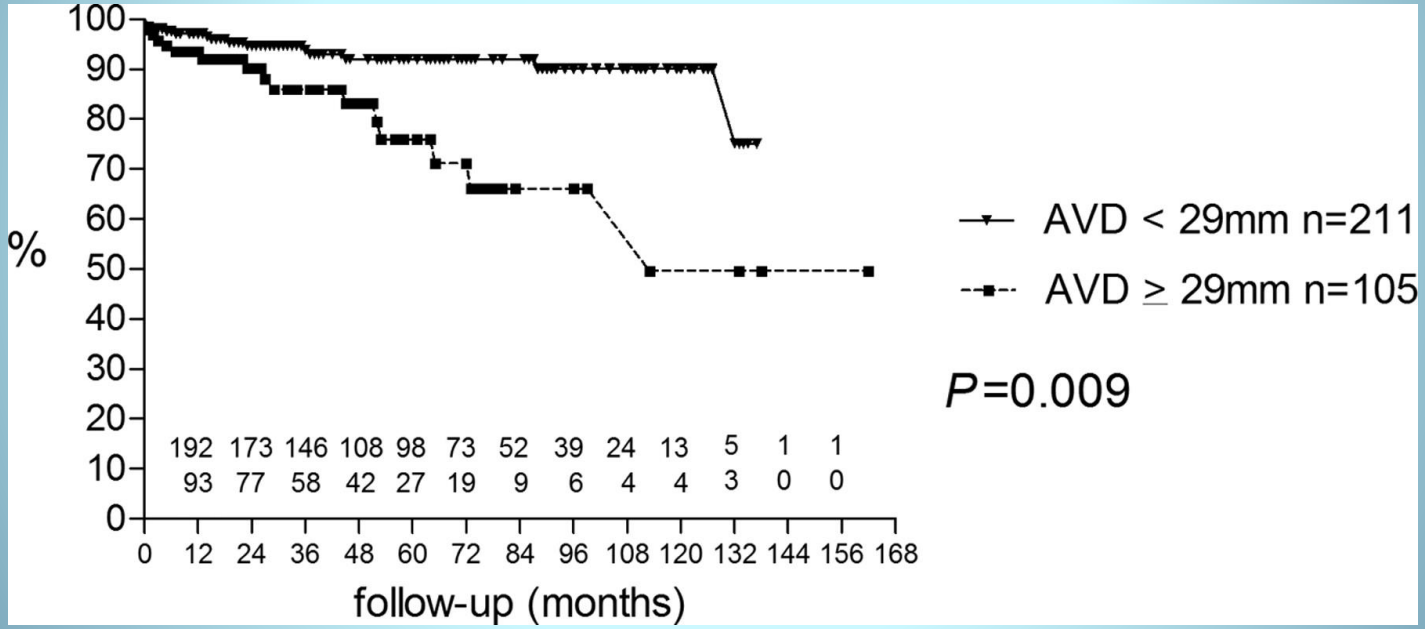




Kunihara et al., JTCVS 2012

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

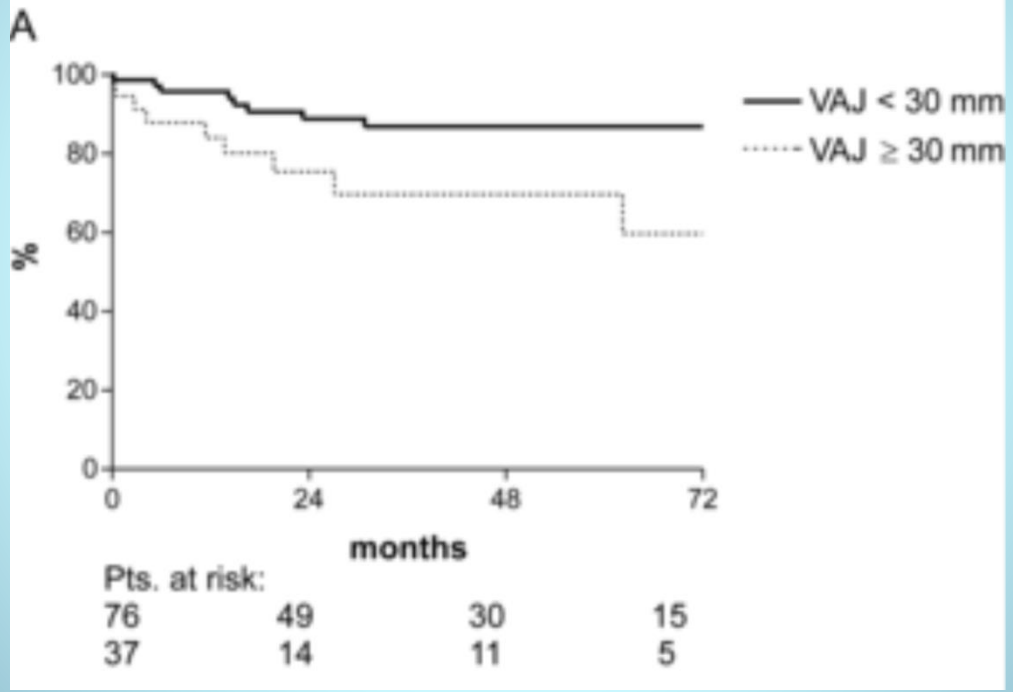
Diana Aicher, MD; Takashi Kunihara, MD; Omar Abou Issa, MD; Brigitte Brittner, MD; Stefan Gräber, MD; Hans-Joachim Schäfers, MD



Aicher et al., Circulation 2011

Effect of annulus dimension and annuloplasty on bicuspid aortic valve repair†

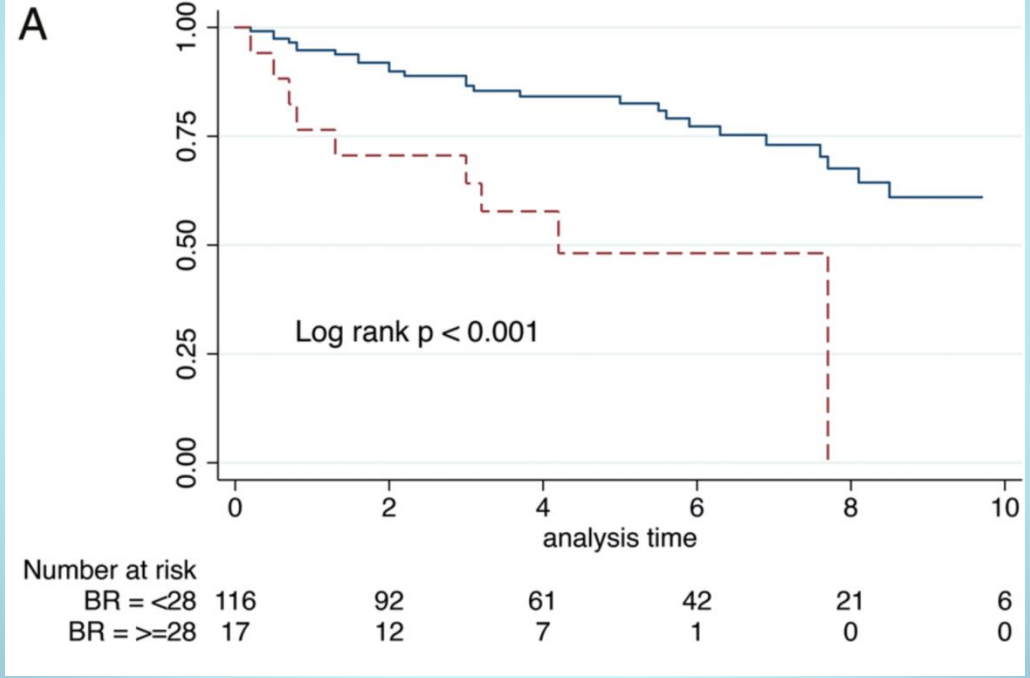
Emiliano Navarra[a], Gebrine El Khoury[a], David Glineur[a], Munir Boodhwani[d], Michel Van Dyck[c], Jean-Louis Vanoverschelde[b], Philippe Noirhomme[a] and Laurent de Kerchove[a,*]



Navarra et al., EJCTS 2013

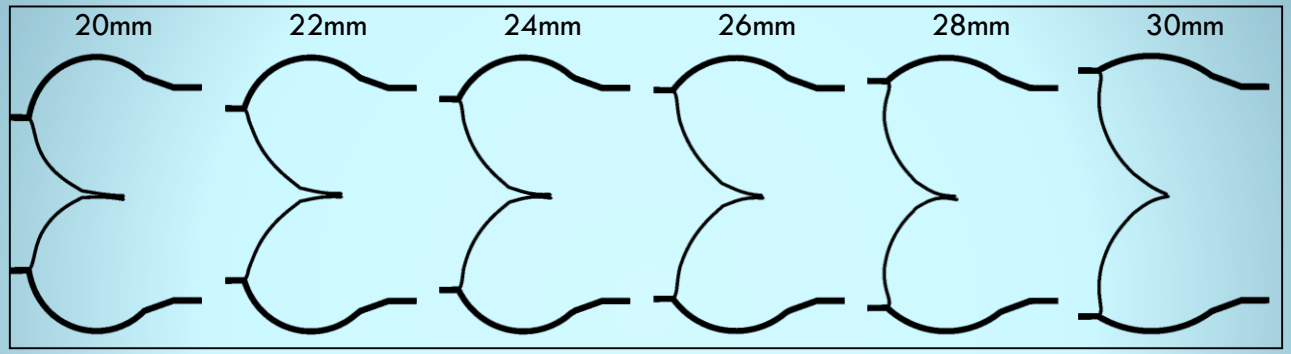
The role of annular dimension and annuloplasty in tricuspid aortic valve repair†

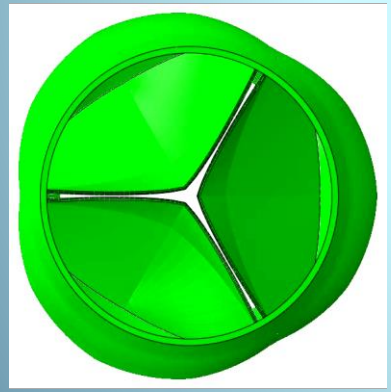
Laurent de Kerchove[a,*], Stefano Mastrobuoni[a], Munir Boodhwani[b], Parla Astarci[a], Jean Rubay[a], Alain Poncelet[a], Jean-Louis Vanoverschelde[a,c], Philippe Noirhomme[a] and Gebrine El Khoury[a]



de Kerchove al., EJCTS 2015

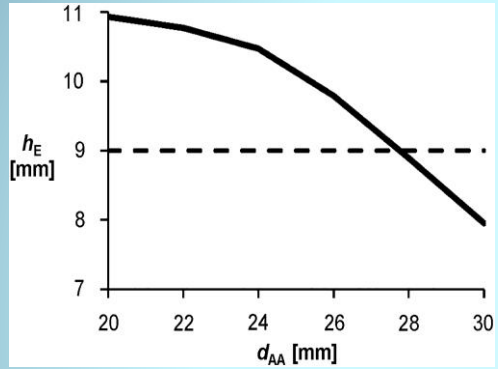
Aortic Root Numeric Model

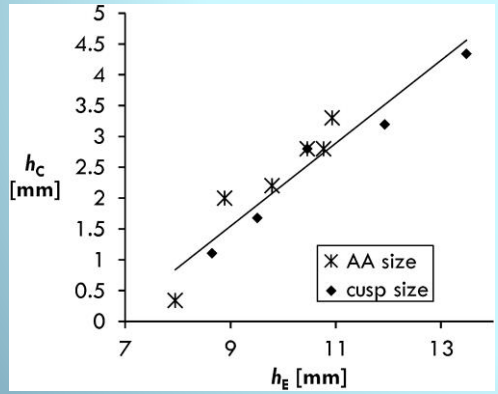


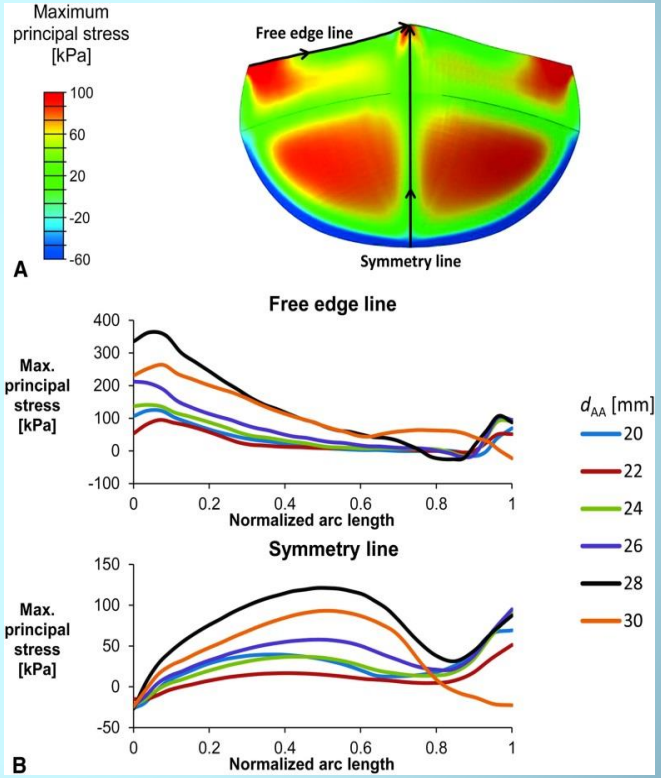


Marom et al., JTCVS 2013

Aortic Root Numeric Model







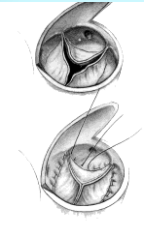
Marom et al., JTCVS 2013

Requirements for Aortic Annuloplasty

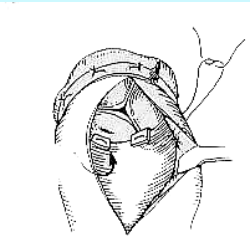
- Safe + stable
- Accomodate changes in shape
- Easily implanted irrespective of muscle in sinus
- No interference with cusps
- No excessive time / myocardial ischemia

Annuloplasties

Cabrol
1966

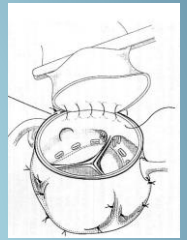


Carpentier
1983

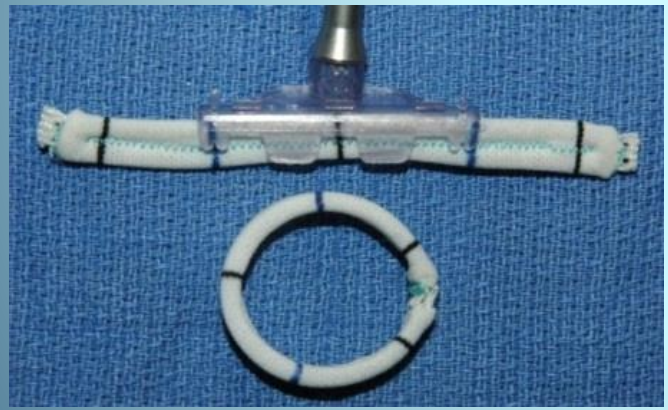


Frater
1986

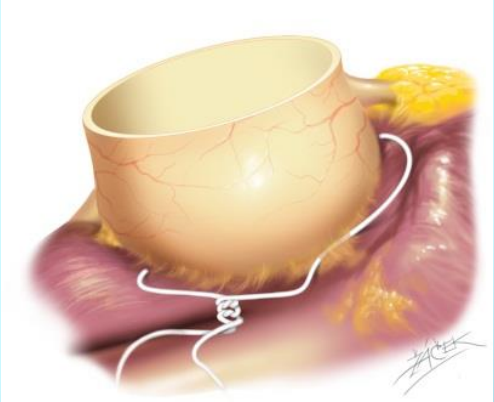
Haydar
1997



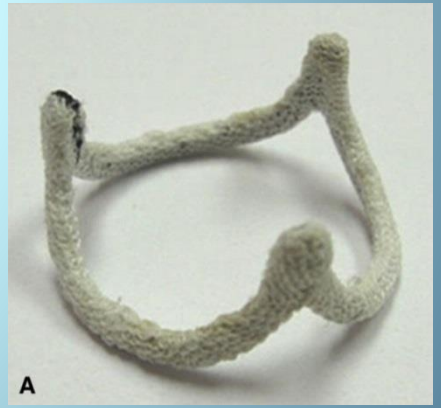
Izumoto
2002



Lansac 2005

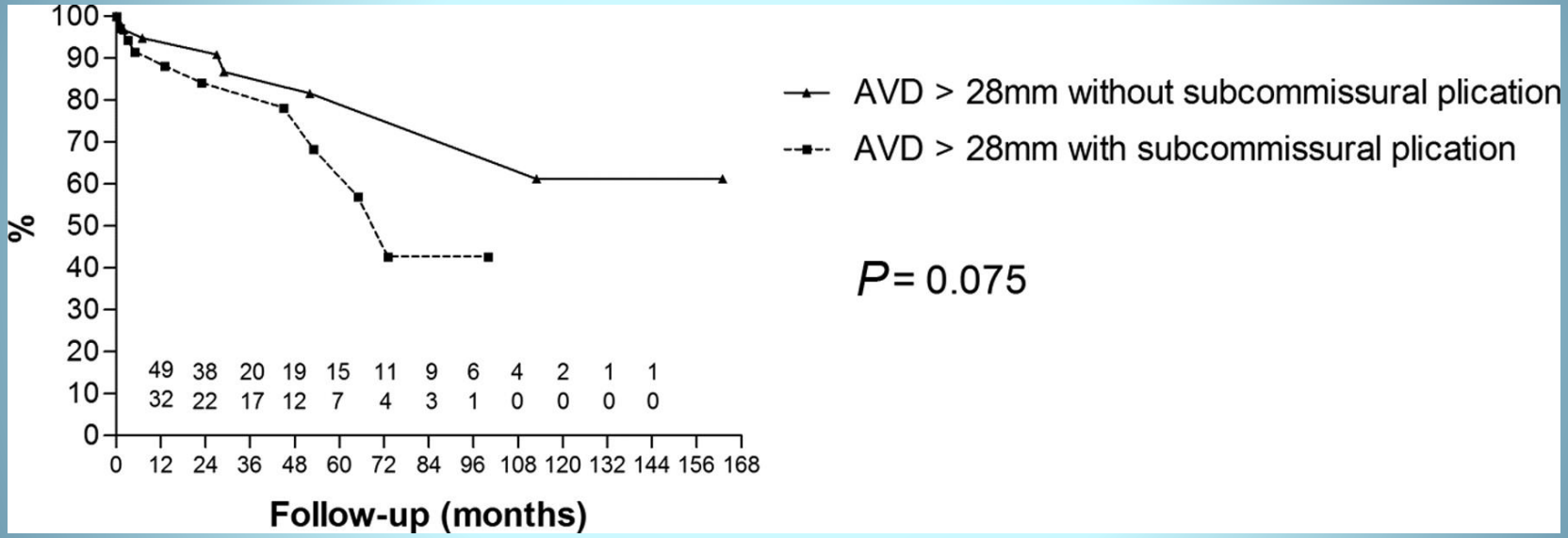


Schäfers 2009



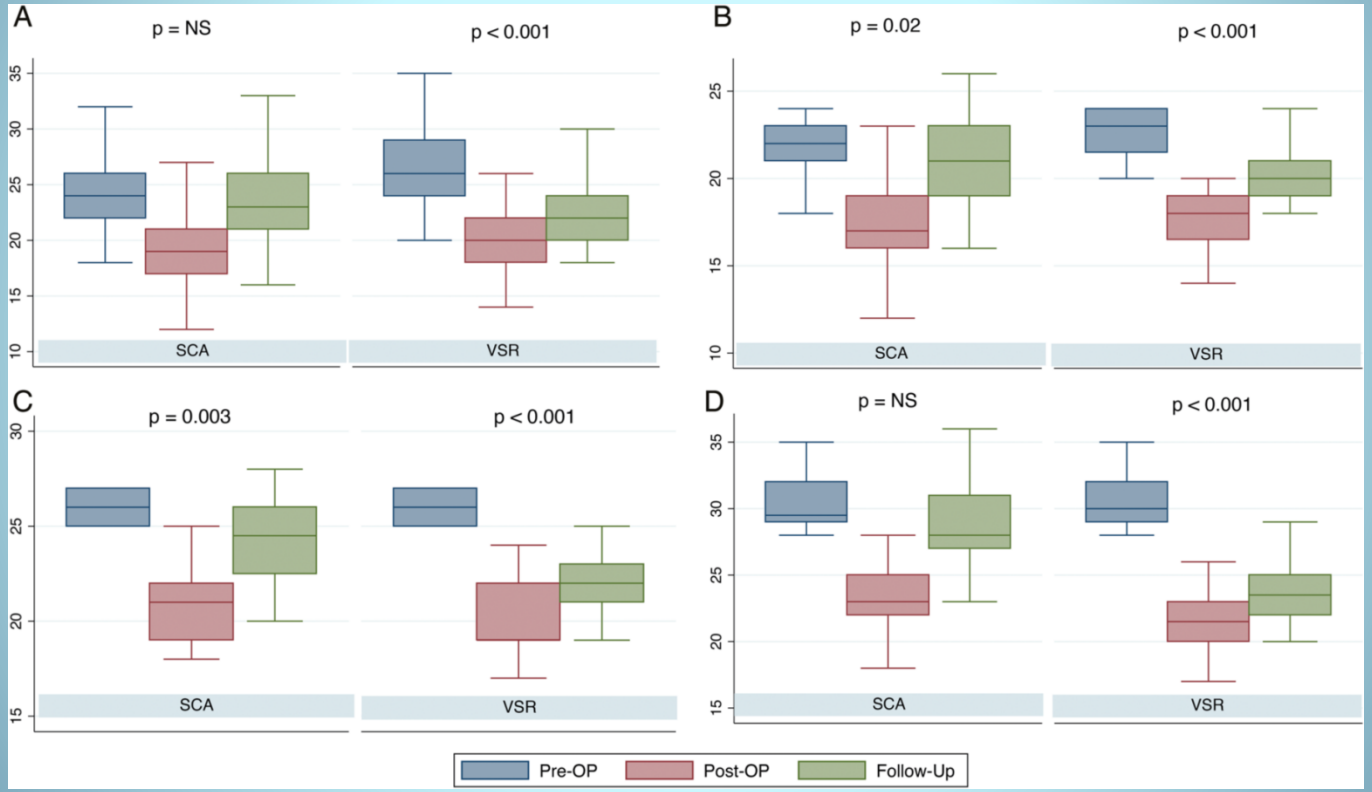
Rankin 2011

Subcommissural Plication



Aicher et al., Circulation 2011

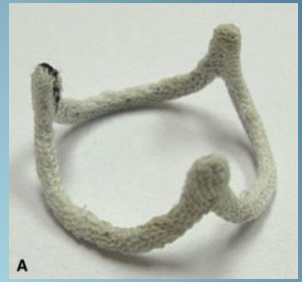
Subcommissural Plication

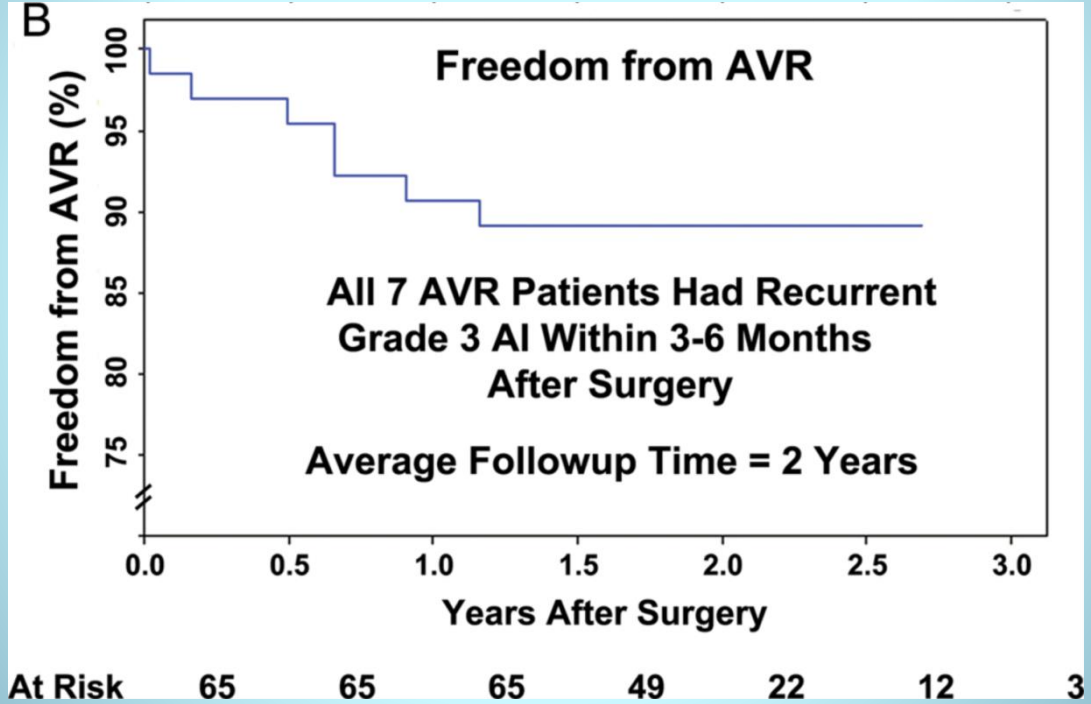


de Kerchove al., EJCTS 2015

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

Domenico Mazzitelli[a], Theodor Fischlein[b], J. Scott Rankin[c,*], Yeong-Hoon Choi[d], Christof Stamm[e], Steffen Pfeiffer[b], Jan Pirk[f], Christian Detter[g], Johannes Kroll[h], Friedhelm Beyersdorf[h], Charles D. Griffin[i], Malakh Shrestha[j], Christian Nöbauer[a], Philip S. Crooke[k], Christian Schreiber[a] and Rüdiger Lange[a]

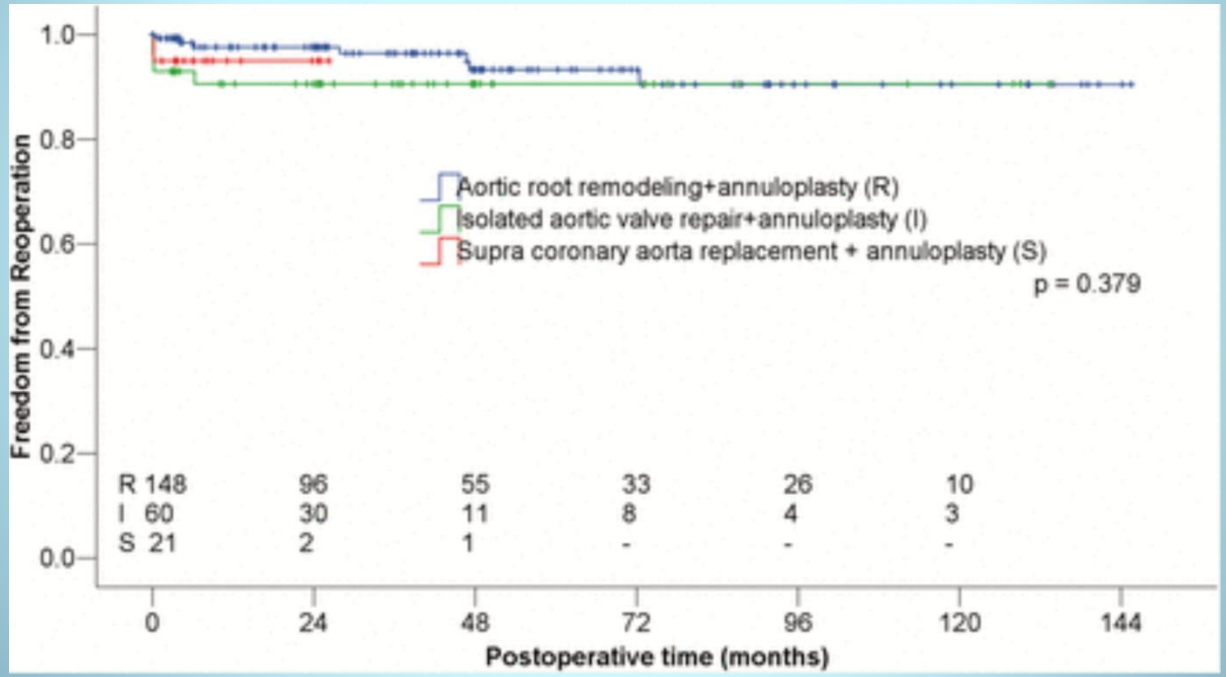




Mazzitelli et al., EJCTS 2015

Long-term results of external aortic ring annuloplasty for aortic valve repair†

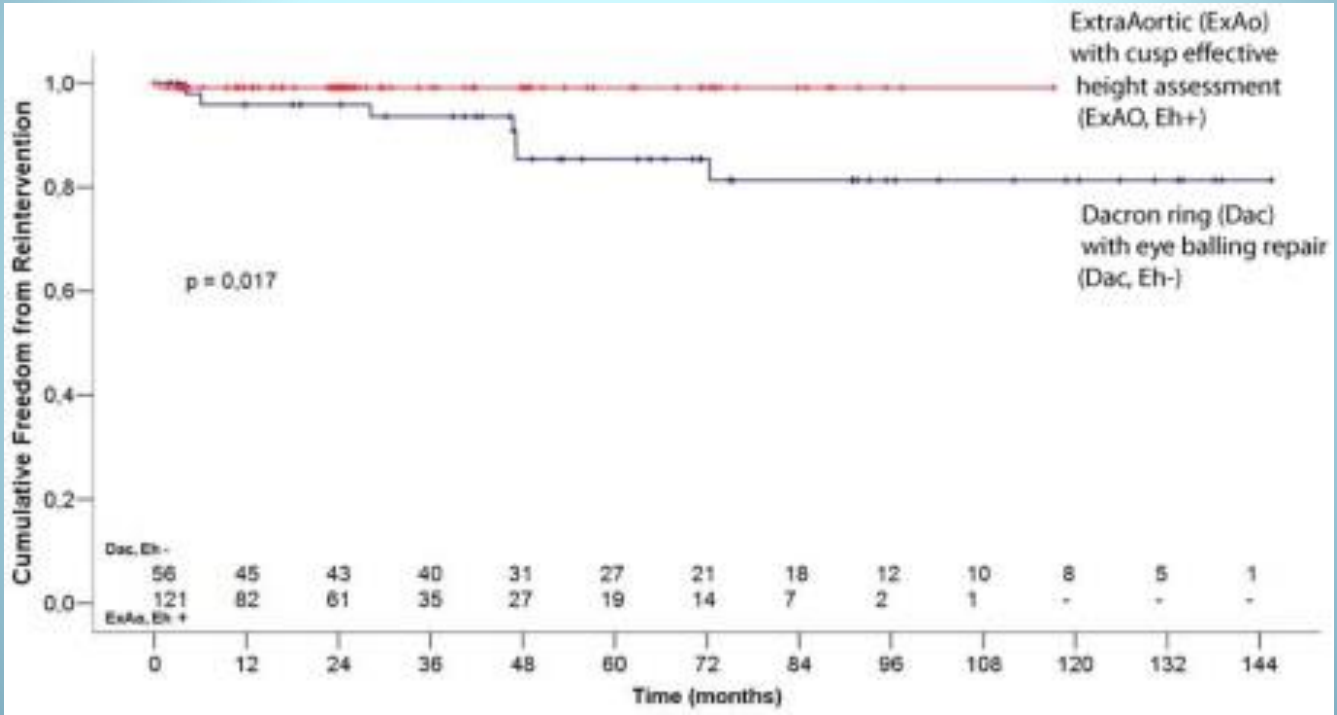
Emmanuel Lansac[a,*], Isabelle Di Centa[b], Ghassan Sleilaty[a], Stephanie Lejeune[a], Nizar Khelil[a], Alain Berrebi[a], Christelle Diakov[a], Leila Mankoubi[a], Marie-Christine Malergue[a], Milena Noghin[a], Konstantinos Zannis[a], Suzanna Salvi[a], Patrice Dervanian[a] and Mathieu Debauchez[a]



Lansac et al., EJCTS 2016

Remodeling root repair with an external aortic ring annuloplasty

Emmanuel Lansac, MD, PhD,[a] Isabelle Di Centa, MD,[b] Ghassan Sleilaty, MD,[a] Stephanie Lejeune, MS,[a] Alain Berrebi, MD,[a] Pavel Zacek, MD, PhD,[c] and Mathieu Debauchez, MD[a]



Lansac et al., JTCVS 2017

Remodeling root repair with an external aortic ring annuloplasty

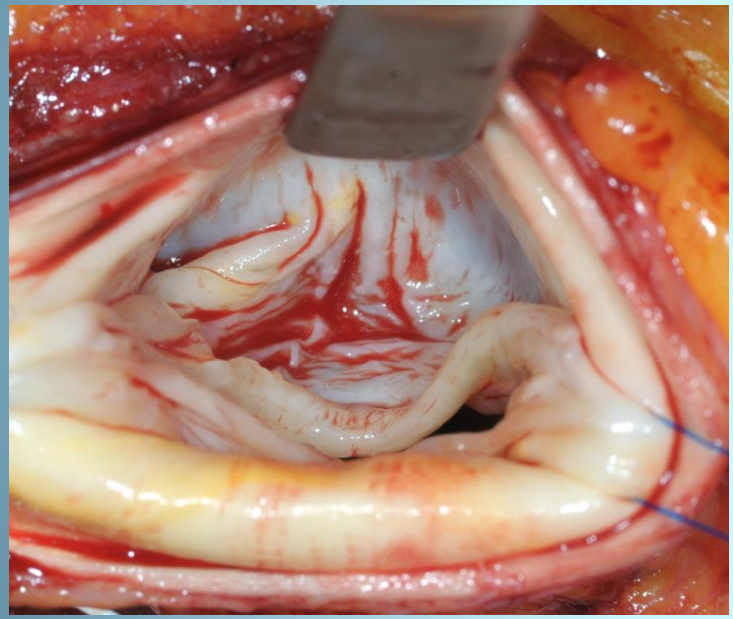
Emmanuel Lansac, MD, PhD,[a] Isabelle Di Centa, MD,[b] Ghassan Sleilaty, MD,[a] Stephanie Lejeune, MS,[a] Alain Berrebi, MD,[a] Pavel Zacek, MD, PhD,[c] and Mathieu Debauchez, MD[a]

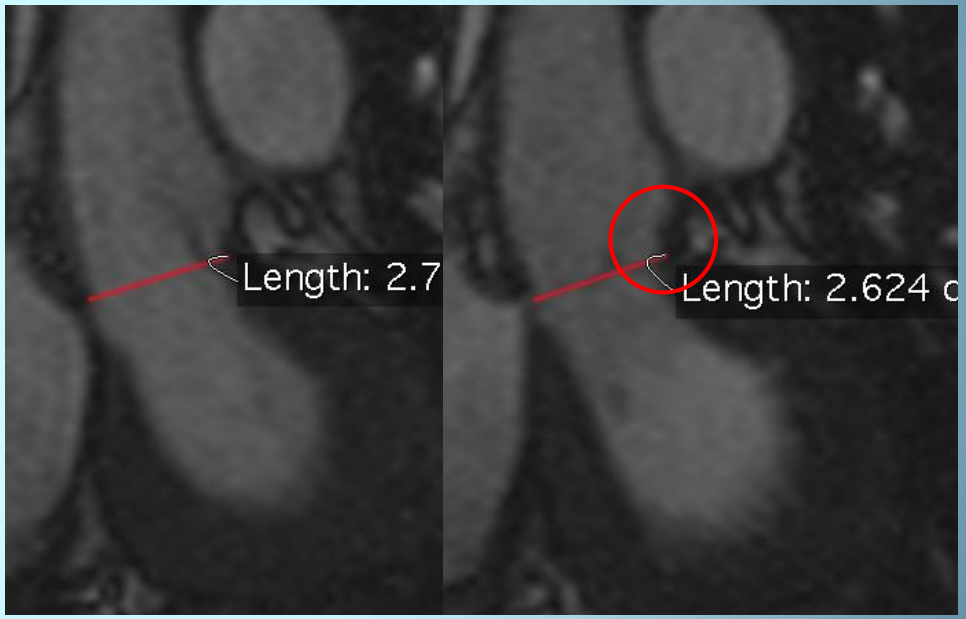
TABLE 3. Influence of different parameters on late outcomes

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

Lansac et al., JTCVS 2017

External Ring – The Homburg Experience

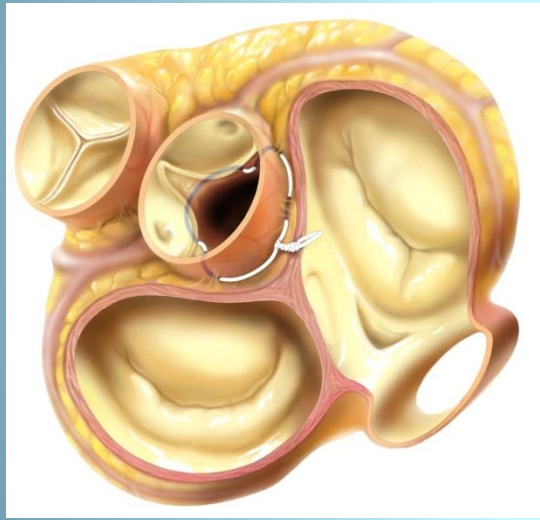




Suture Annuloplasty in Aortic Valve Repair

Ulrich Schneider, MD, Diana Aicher, MD, Yujiro Miura, MD, and Hans-Joachim Schäfers, MD

Department of Thoracic and Cardiovascular Surgery, Saarland University Medical Center, Homburg, Saar, Germany

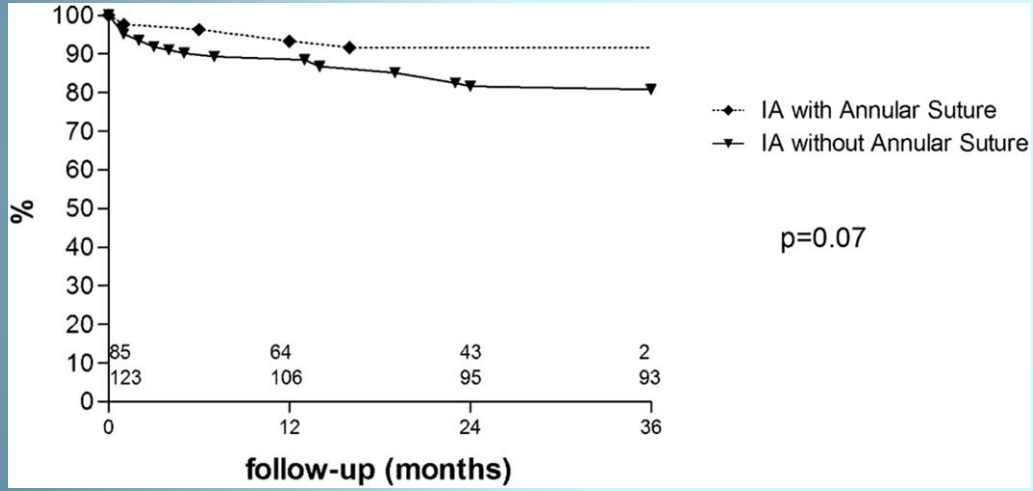


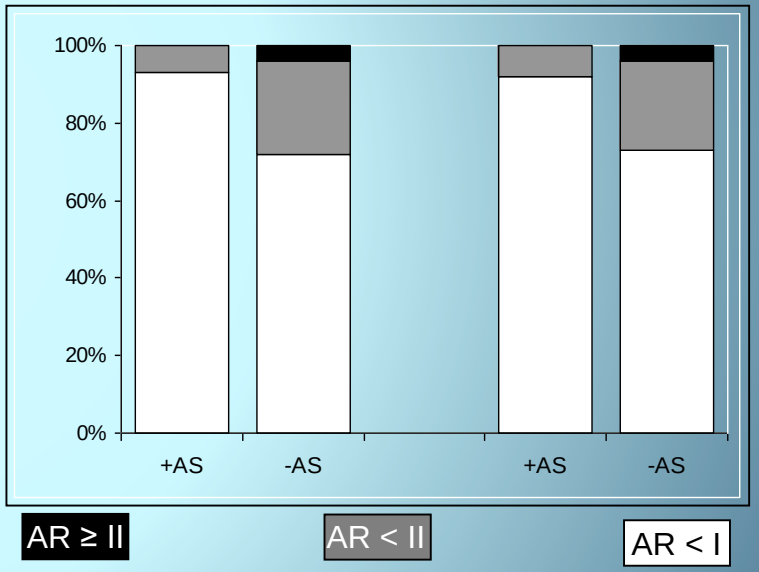
- **First steps**
  - Braided Polyester
  - Isolated AVR and root remodeling
  - Valve competence/stability ↑↑
  - Local complications
    - Tissue erosion into LVOT (n = 3; 2%)
    - VSD (n = 5; 3.3%)
    - Obstruction Cx (n = 2; 1.3%)

    → PTFE

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

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

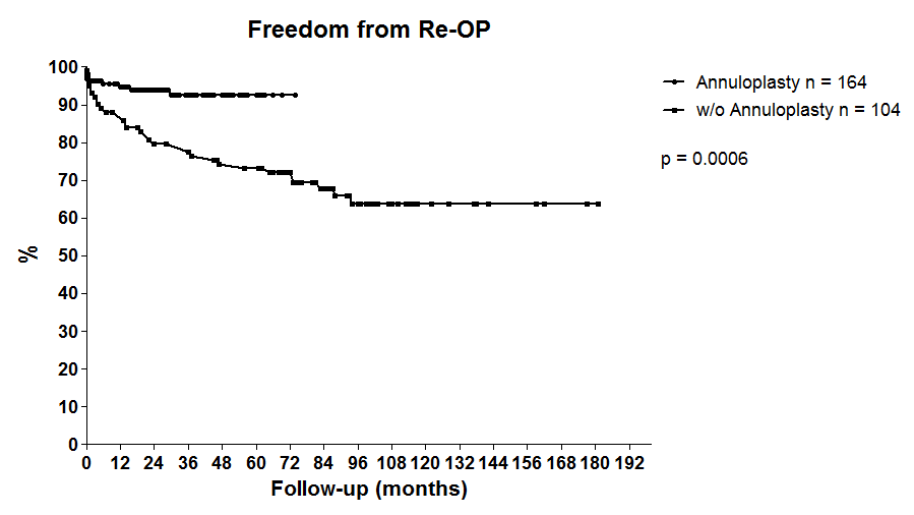


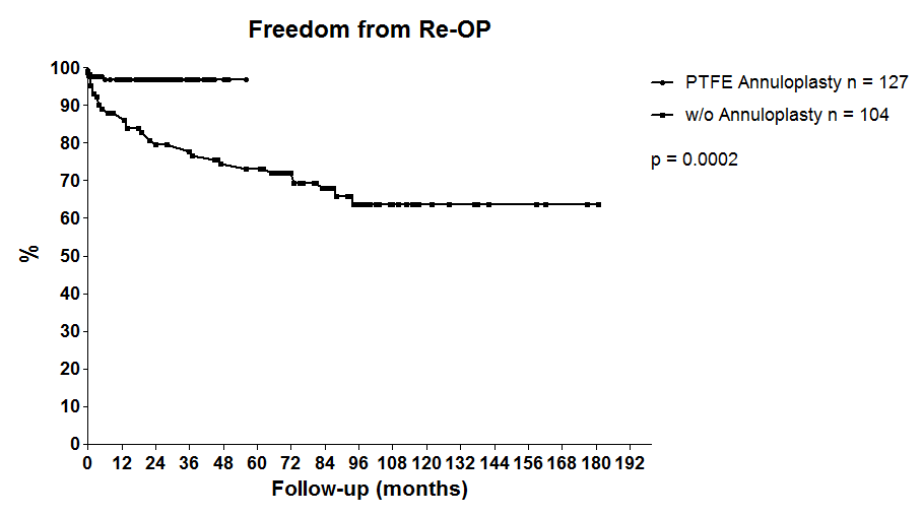


Aicher et al., JTCVS 2013

Suture Annuloplasty Significantly Improves the Durability of Bicuspid Aortic Valve Repair

Ulrich Schneider, MD, Christopher Hofmann, Diana Aicher, MD, Hiroaki Takahashi, MD, Yujiro Miura, MD, and Hans-Joachim Schäfers, MD



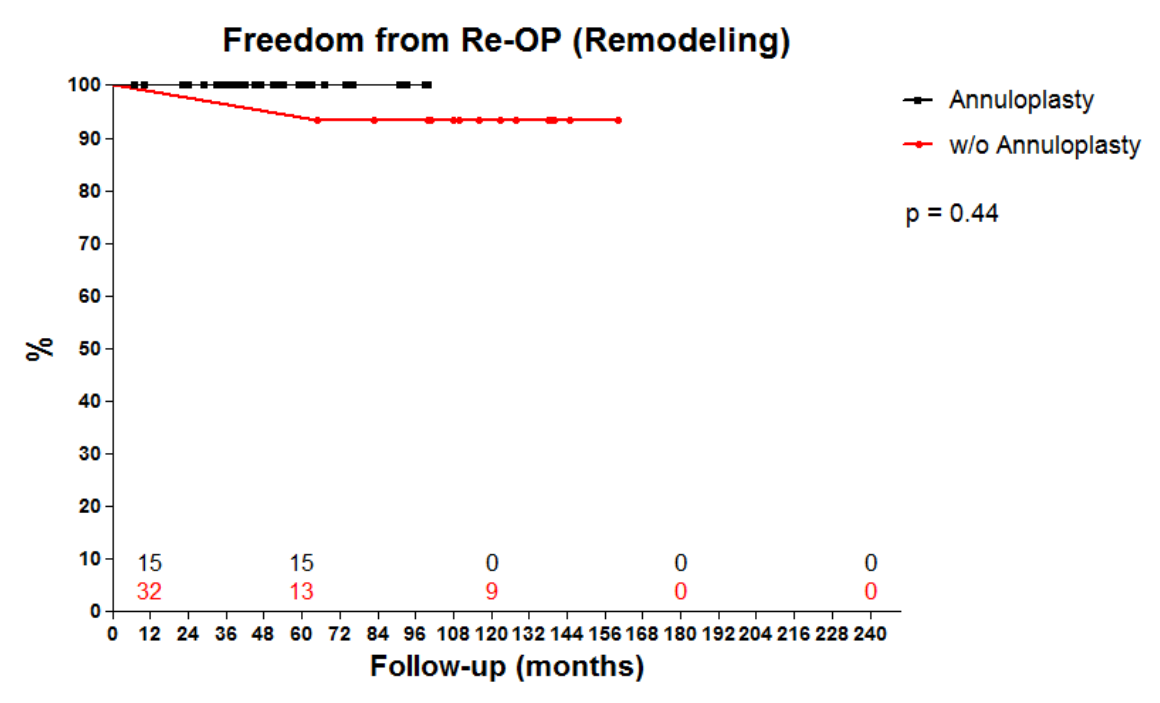


52nd Annual Meeting
Phoenix, Arizona
January 23–27, 2016
The Society of Thoracic Surgeons

Masters of Cardiothoracic Surgery

Valve-sparing aortic root replacement in patients with Marfan syndrome—the Homburg experience

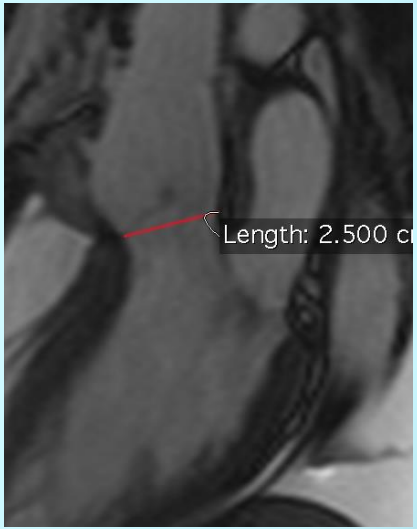
Ulrich Schneider, Tristan Ehrlich, Irem Karliova, Christian Giebels, Hans-Joachim Schäfers



Schneider et al., Ann Cardiothorac Surg 2017

PTFE Annuloplasty

- Placement at basal level independent of AVJ
- Evolution of technique: initially inside-outside, subsequently outside only
- Accomodating changes in shape?



External Ring vs. Suture Annuloplasty

AVIATOR Registry (n=1185 with clear definition, pre-OP echo in 90%, FU in 72%)

	External (n=745)	**PTFE SA** (n=440)	***p***
Centers	31	6	
Age	51 ± 14	49 ± 14	> 0.2
AR pre-OP	2.3 ± 1.3	2.6 ± 0.9	> 0.2
Concomitant Procedures	**50 (6.7%)**	**165 (37.5%)**	**< 0.001**
Remodeling	745 (100%)	440 (100%)	
Cusp Repair	**500 (67%)**	**419 (95%)**	**< 0.001**
X-Clamp (min)	**149 ± 34**	**72 ± 18**	**< 0.001**
Hospital Mortality	13 (1.7%)	3 (0.7%)	> 0.1
AR post-OP	0.27 ± 0.49	0.35 ± 0.51	> 0.2

Annuloplasty – The Evidence

- Basal ring diameter influences aortic valve configuration/competence
- Different techniques with promising results (solely due to annuloplasty?)
- Discrepancy AVJ ↔ Basal Ring

  → Annuloplasty should address basal ring
- Documented evidence for the need of an annuloplasty in isolated BAV repair

Thank you!