## The Evidence for Annuloplasty in Aortic Repair

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# Outilne

- Anatomical definitions
- Historical perspective
- What are the normal diameters?
- Effect of annular dilatation on the durability of AV repair
- What are the options for annuloplasty?
- Clinical results of annuloplasty
- limitations

## What is the aortic annulus?





### Phenotypes of the ascending aorta



Aortic root aneurysm Valsalva ≥45 mm Supra-coronary aneurysm Valsalva <40 mm Supracoronary Aorta >45



Isolated Al Valsalva <40 mm Supracoronary Aorta <40

# The surgical correction of aortic insufficiency by circumclusion

#### Taylor WJ, et al. JTCVS 1958;35:192-231



First subvalvular aortic annuloplasty Beating Heart Right thoracotomy 11 patients, rheumatic disease (8/11)

### Subcommissural plication stitches (Cabrol 1966)



Plicating U stitches at the base of the interleaflet triangles

partial subvalvular annuloplasty

Cabrol C, Treatment of aortic insufficiency by means of aortic annuloplasty. Arch Mal Coeur Vaiss 1966;59:1305–12.

## Aortic annuloplasty for isolated Al **External and Internal**



## Effect of annulus diameter

Six geometries with different annulus diameters

- Calculated by expanding or shrinking the AA of normal case (24mm)
- The other dimensions were not changed



## Influence of the geometry on coaptation





## Coaptation vs. effective height

- Comparison of coaptation during diastole as a function of the effective height
- The effective height correlates well with value coaptation
- The cusps in all the cases with h<sub>E</sub><9mm prolapsed during diastole</p>





# **Restore Normal Root Geometry**





Kunzelman K, 1994

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

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1995-2009, 401 remodeling, 29 re-implantation (24 marfan pts)

Stratified by AVJD



## Effect of annulus dimension and annuloplasty on bicuspid aortic valve repair<sup>†</sup>

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161 BAV patients

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## Internal





### External





## root replacement

# BAV repair (SCA) with dilated annulus (> 27mm): fails in short term





J. Bavaria et al: STS 2013

	Group 1 (n = 53)	Group 2 (n = 53)	P value
Postoperative outcomes			
Mortality	0	0	_
Reoperation for bleeding	6 (11%)	7 (13%)	>.999
Aortic valve reoperation	4 (7.5%)	0	.13
Permanent pacemaker insertion	2 (4%)	4 (8%)	.67
Stroke or transient ischemic attack	2 (4%)	2 (4%)	>.999
Discharge echocardiography*			
Aortic insufficiency grade			
0	26 (53%)	32 (62%)	
1	20 (41%)	19 (36%)	.46
2	3 (6%)	1 (2%)	
Peak gradient			
$\leq$ 20 mm Hg	25 (51%)	42 (81%)	
21-30 mm Hg	14 (29%)	7 (13%)	.006
>30 mm Hg	10 (20%)	3 (6%)	

All data represent numbers and percentages of patients. \*Early reoperation excluded.

30-8)

# Computer Finite Element Model Stress during peak systole

- TAV has the largest opening area
- Highest stress values are found in BAVs with fused cusps
- Raphe region increases stress magnitudes







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

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



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## Expensible band (Lansac 2006)





### 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



### (Ann Thorac Surg 2015;99:1220–7)

# Remodeling root repair with an external aortic ring annuloplasty

Emmanuel Lansac, MD, PhD,<sup>a</sup> Isabelle Di Centa, MD,<sup>b</sup> Ghassan Sleilaty, MD,<sup>a</sup> Stephanie Lejeune, MS,<sup>a</sup> Alain Berrebi, MD,<sup>a</sup> Pavel Zacek, MD, PhD,<sup>c</sup> and Mathieu Debauchez, MD<sup>a</sup>



(J Thorac Cardiovasc Surg 2017;153:1033-42)

CrossMark

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

Freedom from  $AR \ge II$  in

Takashi Kun Heinrich-Vol Hans-Joachii



Cardiovasc Surg 2012;143:1389-95)

а

## PTFE Annuloplasty Kazui, Svensson, Schäfers 2007





# 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



**FIGURE 2.** Postoperative degree of AR at discharge and 12 months after isolated aortic valve repair (- annular suture: without annuloplasty, + annular suture: with annuloplasty). *AR*, Aortic regurgitation.

**FIGURE 4.** Postoperative degree of AR at discharge and 12 months after root remodeling (- annular suture: without annuloplasty, + annular suture: with annuloplasty). *AR*, Aortic regurgitation.

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



## Freedom from reoperation after BAV repair in patients with preoperative AVD of >28 mm depending on the use of root replacement.



Significant failure in patients with a > 28 mm Annulus whether they have a SCA or "Remodeling" Root.

Aicher D et al. Circulation 2011;123:178-185

### The role of annular dimension and annuloplasty in tricuspid aortic valve repair<sup>†</sup>

Laurent de Kerchove<sup>a,\*</sup>, Stefano Mastrobuoni<sup>a</sup>, Munir Boodhwani<sup>b</sup>, Parla Astarci<sup>a</sup>, Jean Rubay<sup>a</sup>, Alain Poncelet<sup>a</sup>, Jean-Louis Vanoverschelde<sup>a,c</sup>, Philippe Noirhomme<sup>a</sup> and Gebrine El Khoury<sup>a</sup>



### Freedom from recurrent AI



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## **Evidence Limitations**

- Series are mixed (root, BAV, TAV)
- Throughout time, several concomitant additional surgical maneuvers were performed in the same pts cohort difficult to isolate the effect of annuloplasty
- The degree of annuloplasty needed for the individual pt is not well defined and should be correlated at least to cusp size

# Thank you





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### A Regulated Trial of Bicuspid Aortic Valve Repair Supported by Geometric Ring Annuloplasty

Domenico Mazzitelli, MD, Steffen Pfeiffer, MD, J. Scott Rankin, MD, Theodor Fischlein, MD, Yeong-Hoon Choi, MD, Thorsten Wahlers, MD, Christian Nöbauer, MD, Christian Schreiber, MD, and Rüdiger Lange, MD

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16 pts , 2 leaflet tears

#### (Ann Thorac Surg 2015;99:2010–6)

## **Annulus in Different Phenotypes**

**Root aneurysm** 

