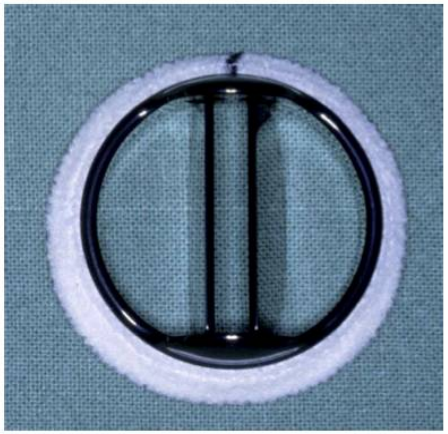
Διατήρηση της Αορτικής Βαλβίδας στην Αντικατάσταση της Αορτικής Ρίζας

Π. Σφυρίδης

Καρδιοχειρουργός

Γιατί να διατηρούμε την AoV;

Aortic Valve Replacement



Valve-related Complications:

- Bleeding
- Thromboembolism
- Endocarditis
- Valve degeneration

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

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Abstract

Objective: Aortic valve replacement for aortic regurgi
complications. Aortic valve repair is an alternative appr
period, 640 patients underwent aortic valve repair for re
($n = 3$) aortic valve. The mechanism of regurgitation in
($n = 323$) or combined pathologies. Treatment consisted
patients were followed clinically and echocardiograph
Results: Hospital mortality was 3.4% in the total patien
(0.2% per patient per year) and endocarditis (0.16%per p
in bicuspid and 97% and 93% in tricuspid aortic valves (p
replacement was 95% and 90% in bicuspid and 97% and 94
years was 88%. **Conclusions:** Reconstructive surgery of th
Freedom from valve-related complications after valve
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Freedom from all valve-related complications at 10 years was 88%.

Freedom from valve-related complications after valve repair seems superior compared to available data on standard aortic valve replacement.

Διατήρηση AoV

Patient Selection

What valve pathology can be repaired?

- Bi- /tricuspid aortic valves with preservation of the natural design (Aicher JTCVS 2004; Schäfers ATS 2007)
- Unicuspid switched to bicuspid design (Schäfers ATS 2008)
- Quadricuspid switched to tricuspid design (Schmidt ATS 2008)

Ποιές βαλβίδες επιδιορθώνονται;

Can the Valve be repaired?

Tissue quality

Calcium

Rheumatic disease

Can the Valve be repaired?

BAV

Aneurysm

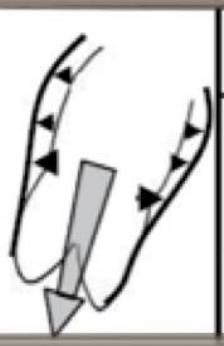
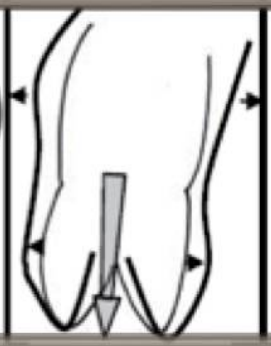
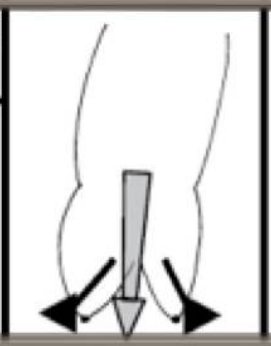
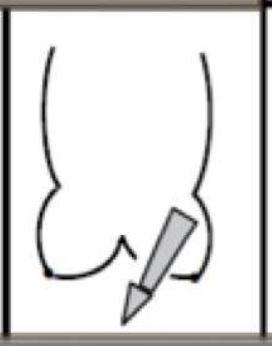
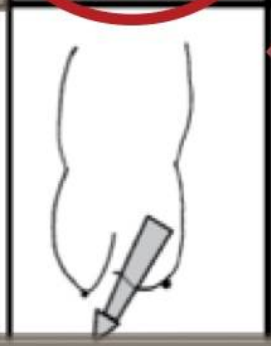
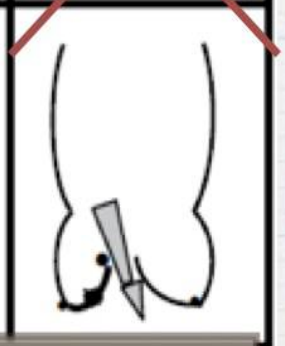
Leaflet prolapse

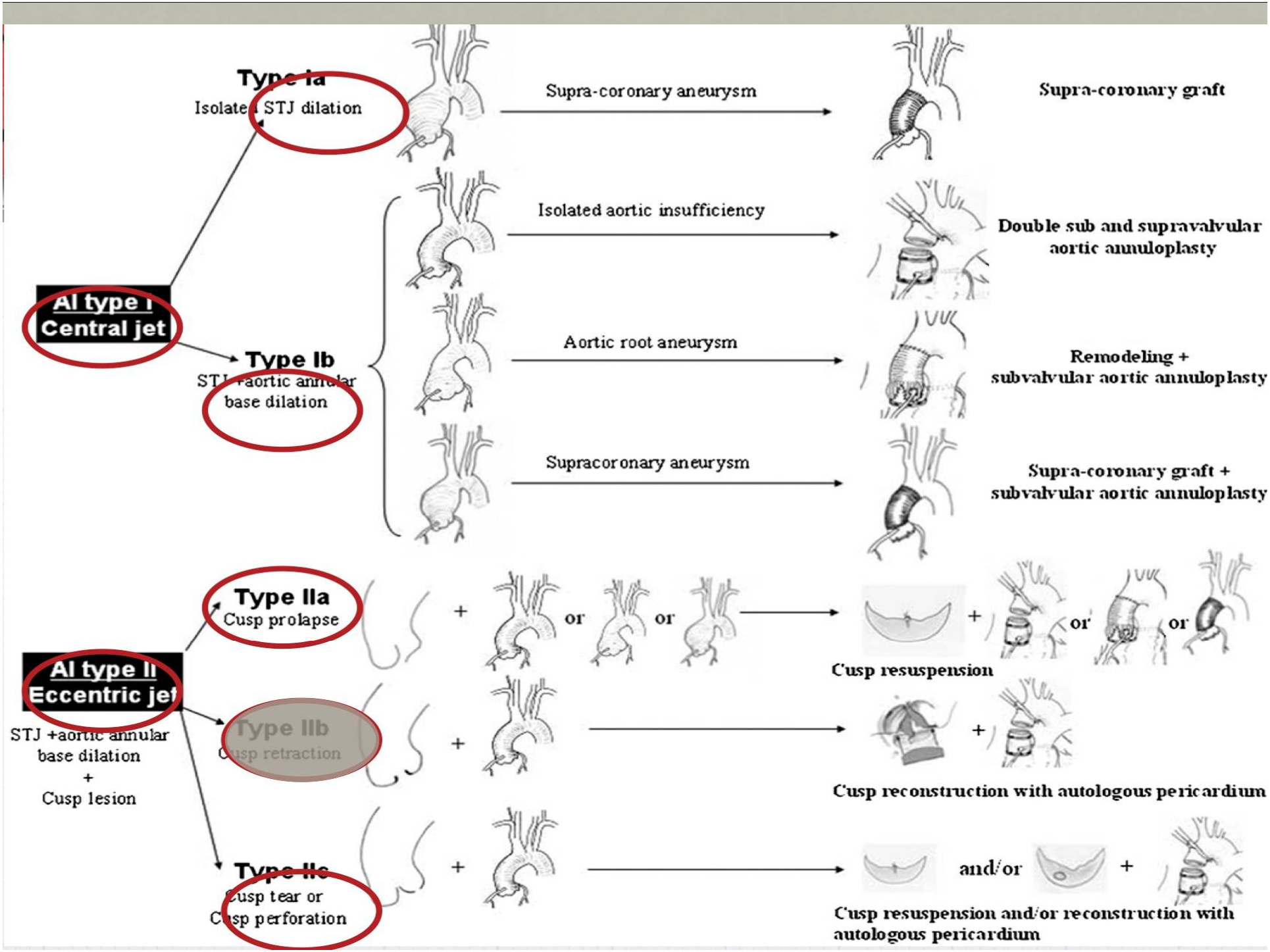
Acute dissection

Autograft failure

Endocarditis

Can the Valve be repaired?

AI Class	Type I Normal cusp motion with FAA dilatation or cusp perforation				Type II Cusp Prolapse	Type III Cusp Restriction
	Ia	Ib	Ic	Id		
Mechanism						
Repair Techniques (Primary)	STJ remodeling *Ascending aortic graft*	Aortic Valve sparing: *Reimplantation or Remodeling with SCA*	SCA	Patch Repair *Autologous or bovine pericardium*	Prolapse Repair *Plication* *Triangular resection* *Free margin Resuspension* *Patch*	Leaflet Repair *Shaving* *Decalcificatio* *Patch*
(Secondary)	SCA		STJ Annuloplasty	SCA	SCA	SCA


Type Ia
Isolated STJ dilation
Supra-coronary aneurysm
Supra-coronary graft
AI type I
Central jet
Isolated aortic insufficiency
Double sub and supravalvular aortic annuloplasty
Type Ib
STJ +aortic annular base dilation
Aortic root aneurysm
Remodeling + subvalvular aortic annuloplasty
Supracoronary aneurysm
Supra-coronary graft + subvalvular aortic annuloplasty
Type IIa
Cusp prolapse
or
or
or
or
Cusp resuspension
AI type II
Eccentric jet
STJ +aortic annular base dilation
+
Cusp lesion
Type IIb
Cusp retraction
Cusp reconstruction with autologous pericardium
Type IIc
Cusp tear or
Cusp perforation
and/or
Cusp resuspension and/or reconstruction with autologous pericardium

Aortic valve
Tricuspid

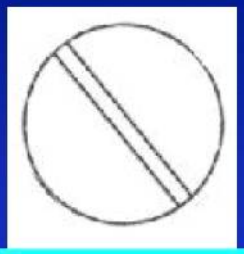
Bicuspid valve

Type 0
0 raphe

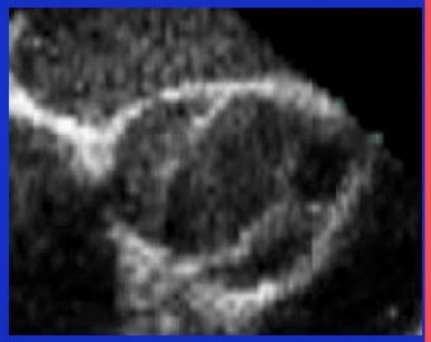
Type 1
1 raphe

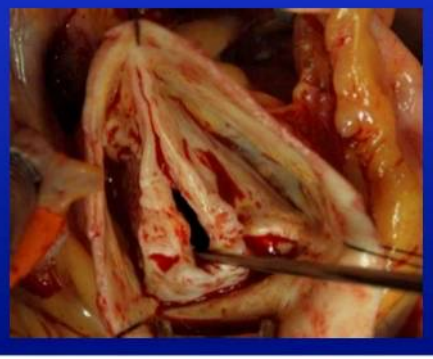
Unicuspid valve

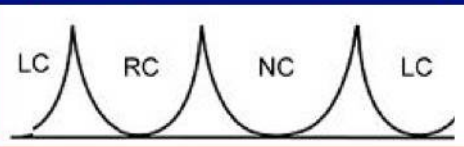
Type 2
2 raphes

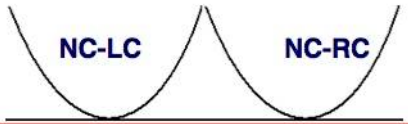


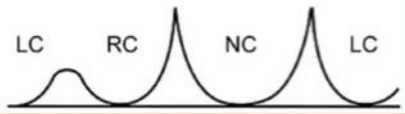
Good candidates for repair

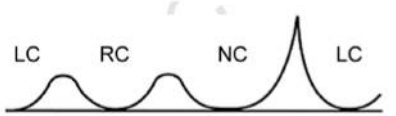




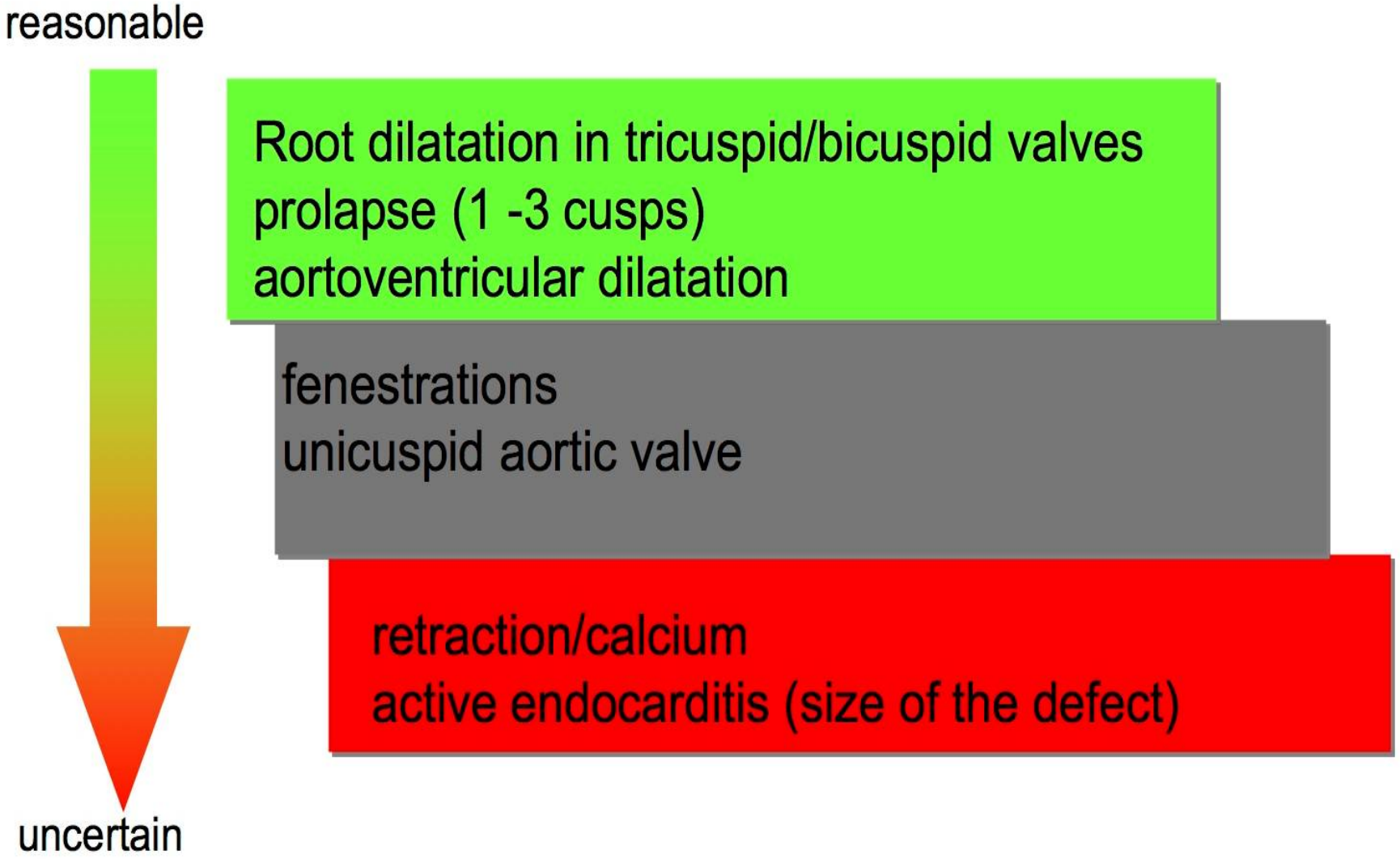








Levels of Difficulty in Aortic Valve Repair



Aortic Valve Repair Using a Differentiated Surgical Strategy

Frank Langer, MD; Diana Aicher, MD; Anke Kissinger, Olaf Wendler, MD; Henning Lausberg, MD; Roland Fries, MD; Hans-Joachim Schäfers, MD

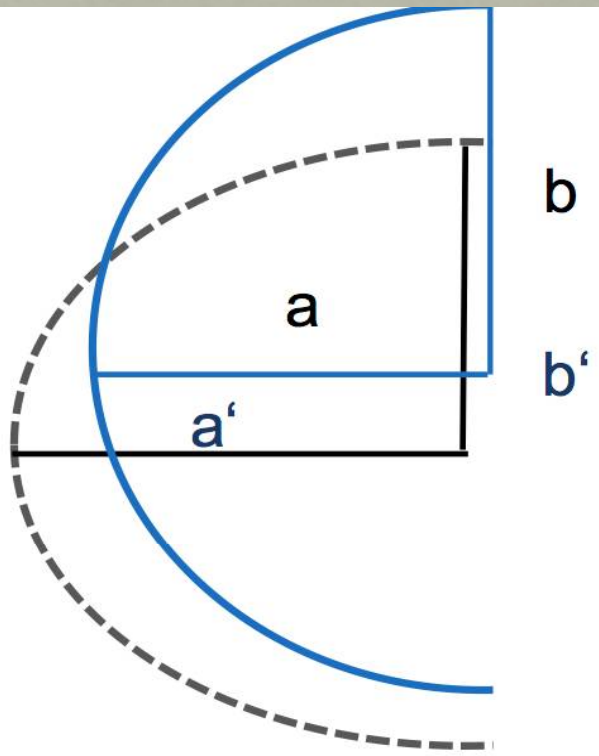
Background—Reconstruction of the aortic valve for aortic regurgitation (AR) remains challenging, in part because of not only cusp or root pathology but also a combination of both can be responsible for this valve dysfunction. We have systematically tailored the repair to the individual pathology of cusps and root.

Methods—Between October 1995 and August 2003, aortic valve repair was performed in 282 of 493 patients undergoing surgery for AR and concomitant disease. Root dilatation was corrected by subcommissural plication (n=59), supracommissural aortic replacement (n=27), root remodeling (n=175), or valve reimplantation within a graft (n=24). Cusp prolapse was corrected by plication of the free margin (n=157) or triangular resection (n =36), cusp defects were closed with a pericardial patch (n=16). Additional procedures were arch replacement (n=114), coronary artery bypass graft (n=60) or mitral repair (n=24). All patients were followed-up (follow-up 99.6% complete), and cumulative follow-up was 8425 patient-months (mean, 33±27 months).

Results—Eleven patients died in hospital (3.9%). Nine patients underwent reoperation for recurrent AR (3.3%). Actuarial freedom from AR grade ≥II at 5 years was 81% for isolated valve repair, 84% for isolated root replacement, and 94% for combination of both; actuarial freedom from reoperation at 5 years was 93%, 95%, and 98%, respectively. No thromboembolic events occurred, and there was 1 episode of endocarditis 4.5 years postoperatively.

Conclusions—Aortic valve repair is feasible even for complex mechanisms of AR with a systematic and individually tailored approach. Operative mortality is low and mid-term durability is encouraging. The incidence of valve-related morbidity is low compared with valve replacement. (***Circulation*. 2004;110[suppl II]:II-67–II-73.**)

Reduction of STJ and Cusp Prolapse

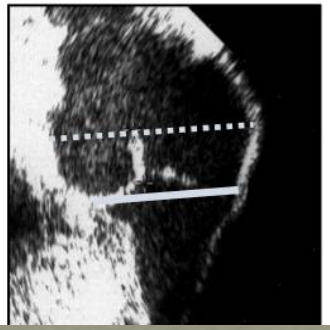


$$C_E = \pi \times [3/2\times(a+b) - \sqrt{a\times b}]$$

$b \approx r_{aorta}$

$a \approx r_{cusp}$

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



Standardized Aortic Valve repair

Root pathology

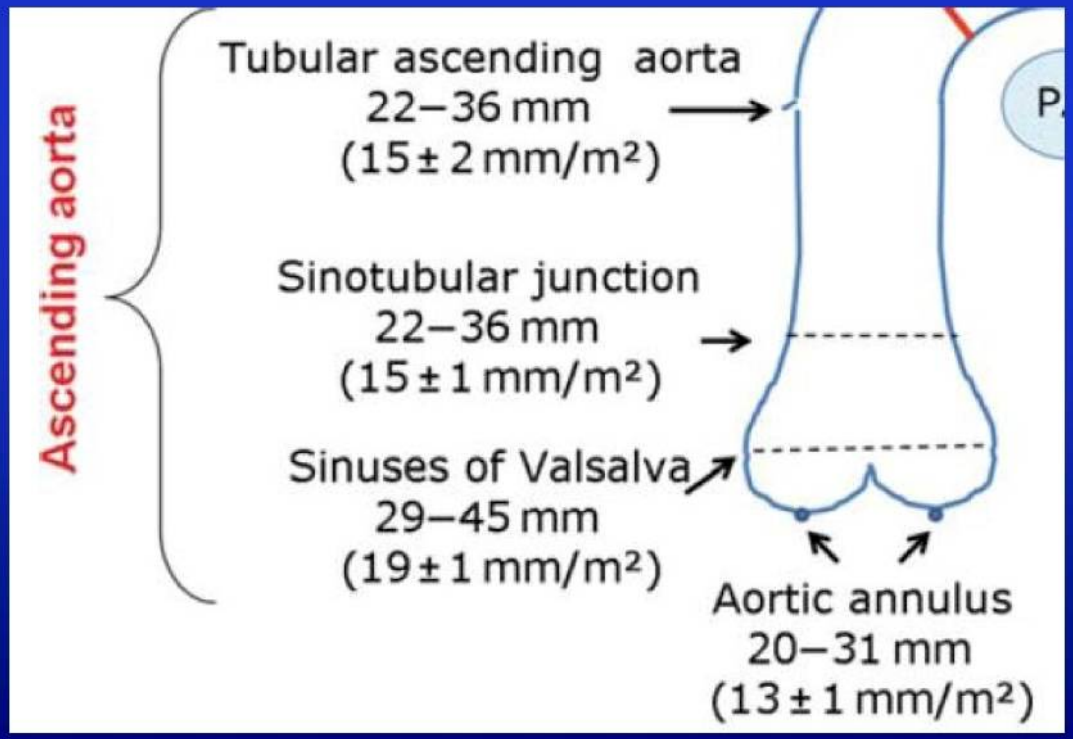
Assessment

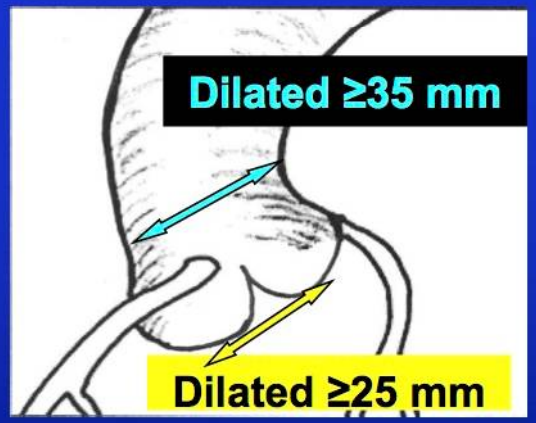
Correction

Valve morphology
Cusp pathology

What are the normal diameters of the aortic root?

N	1132
Annulus Ø	22.3±1,4 (20.5-32.4)
STJ Ø	26.7±2.2 (31.2-23.4)
STJ/ annulus	1.2±0.1 (1.1-1.3)





STJ> Annulus
Ratio = 1.2 (1.1-1.3)

Roman 1987 Nistri 1999 Varnous 2003 Maselli 2005 Babee 2007 Tamas 2007 Soncini 2009 Bierbach 2010 Zhu 2011

Root Assessment

Echo:

Maximum sinus diameter ► >40 / 45 mm?

ST diameter ► >35 (?)

Annular diameter (?)

Intraoperative:

Annular diameter (!) ► >25 / 28 mm?

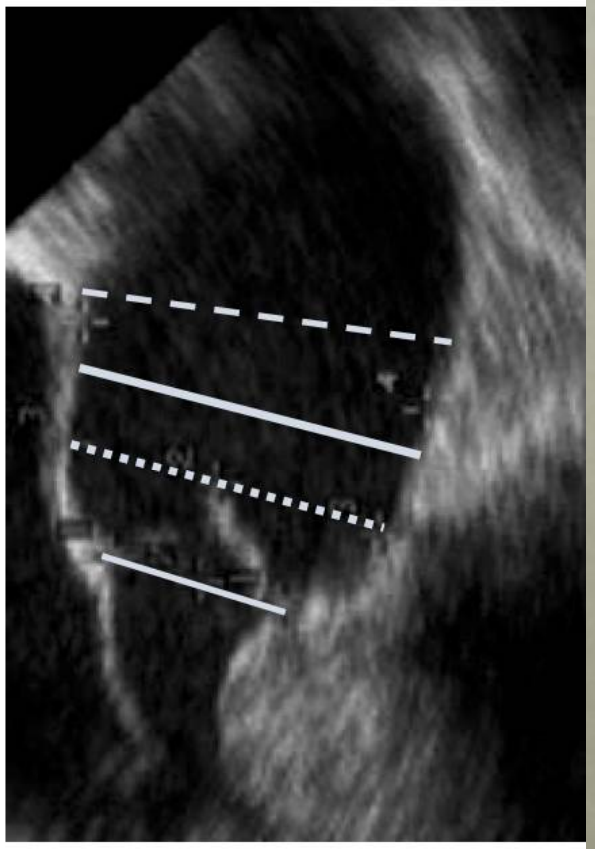
AI and TTE/TEE

Root dimensions

AV morphology (bi-/tricuspid)

Prolapse

Calcification?



Cusp Assessment

Echo:

- Valve morphology?
- Eccentricity of jet?

Intraoperative:

- Valve Morphology?
- Cusp height/configuration?
- Cusp substance?

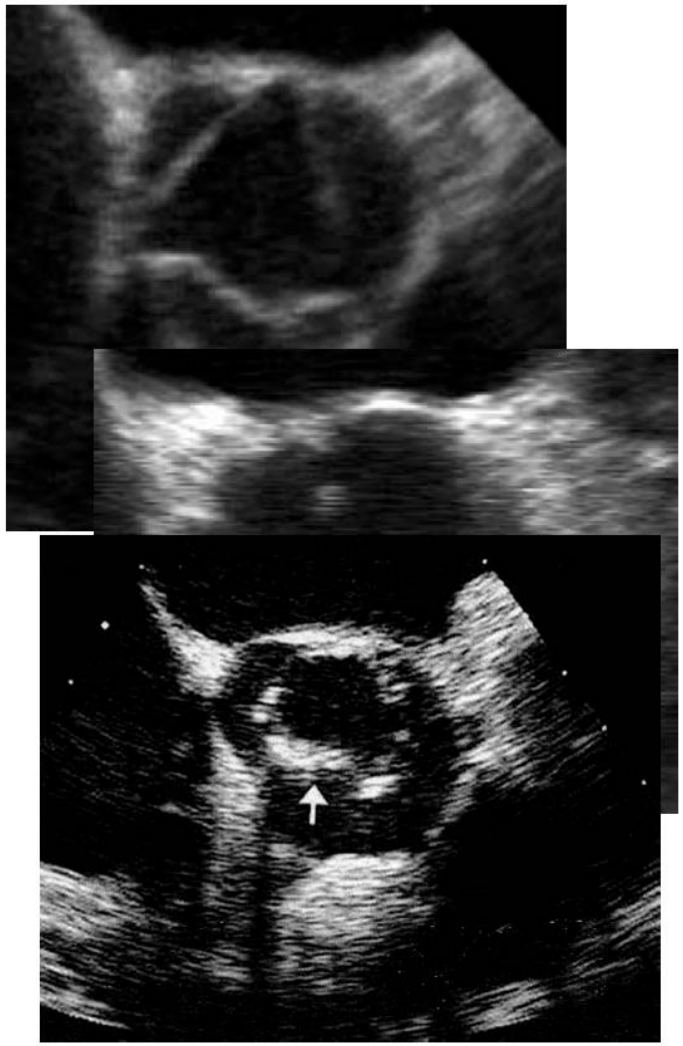
AI and TTE/TEE

Root dimensions

AV morphology (bi-/tricuspid)

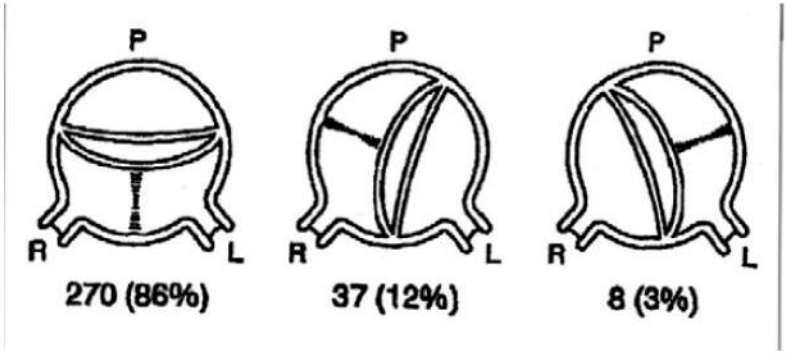
Prolapse

Calcification?

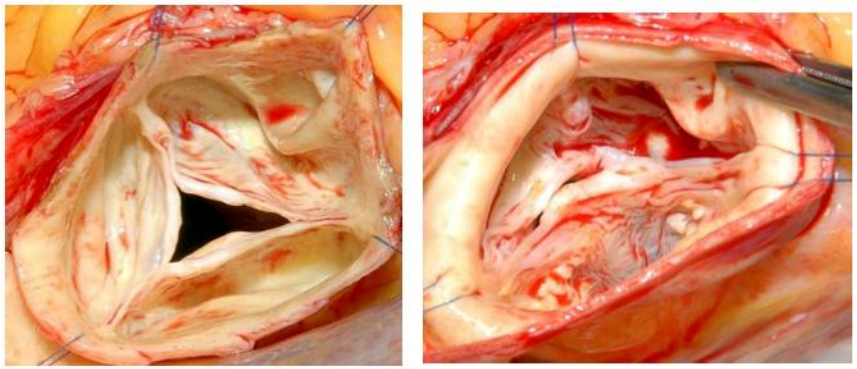


Bicuspid Aortic Valve (BAV) Morphology

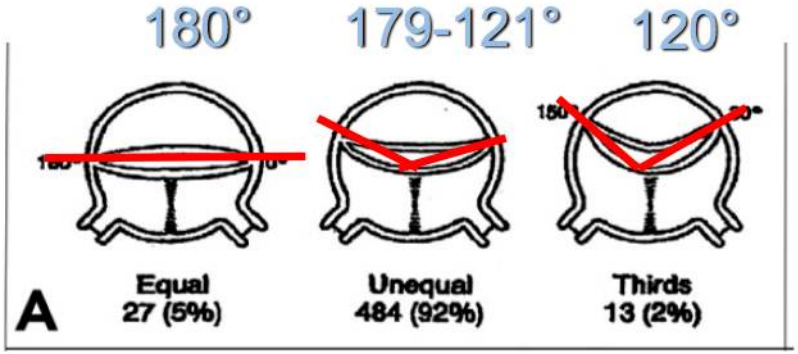
pattern of fusion



degree of fusion



commissural orientation

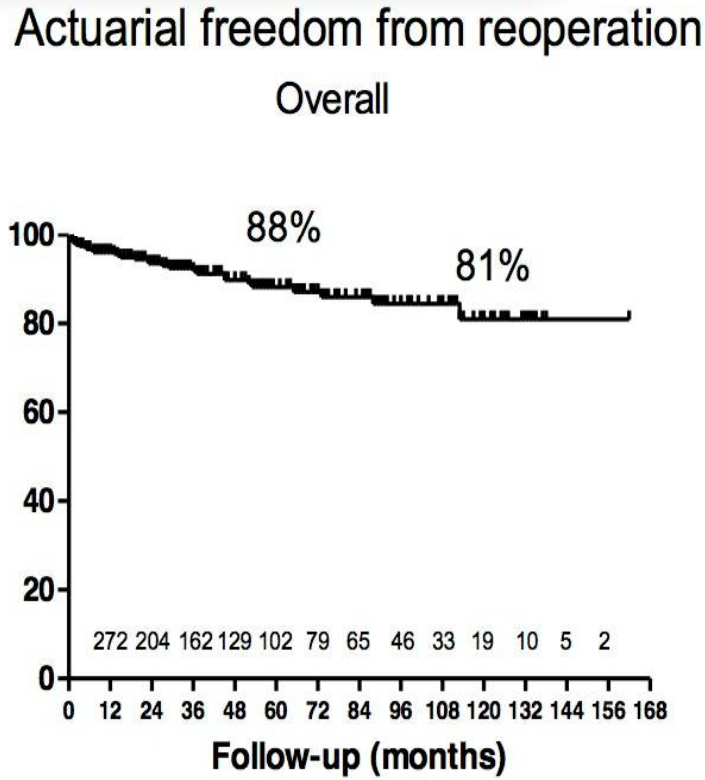


Sabet et al, *Mayo Clin Proc*, 1999;74:14-26

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

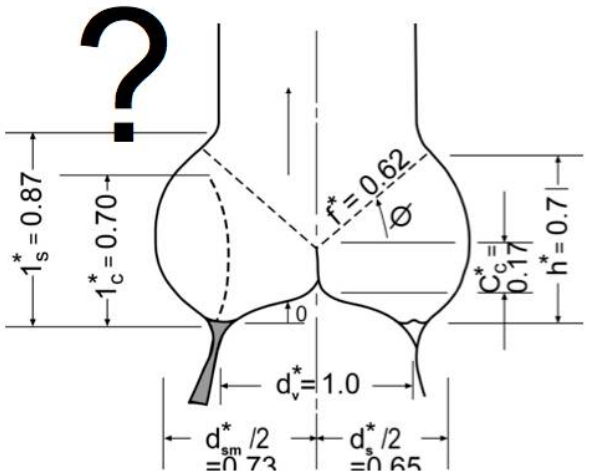
Type of fusion		
	right/left	281 (89%)
	right/non	30 (9%)
	left/non	5 (1%)
Commissural orientation		
	>160°	51
	≤160°	265
Fusion		
	partial	122
	complete	194

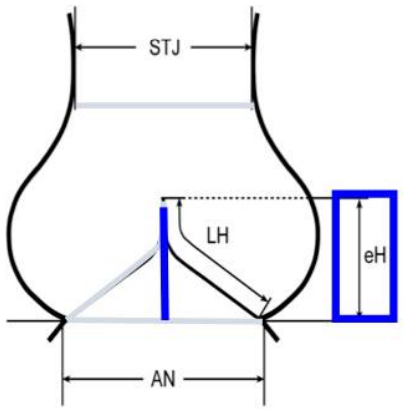


Aicher et al. Circulation 2011 Jan 18;123(2):178-85

Aortic Valve Repair-Assessment

Configuration of cusps



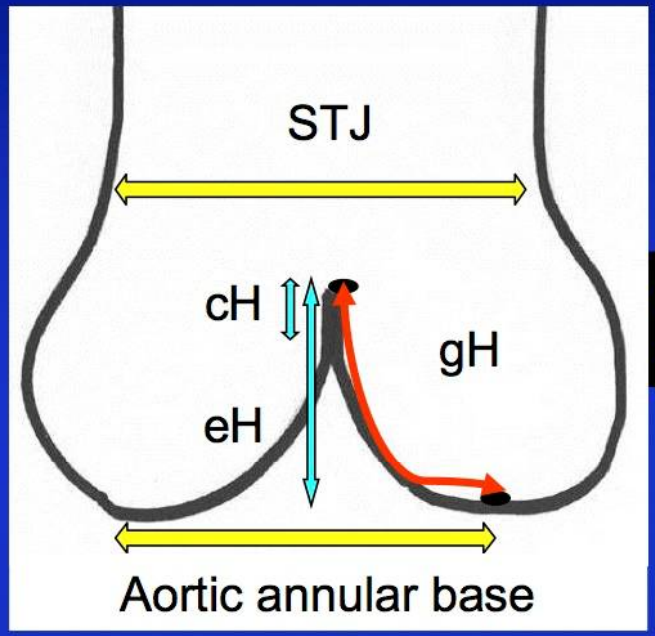


Swanson, Circ Res 1974

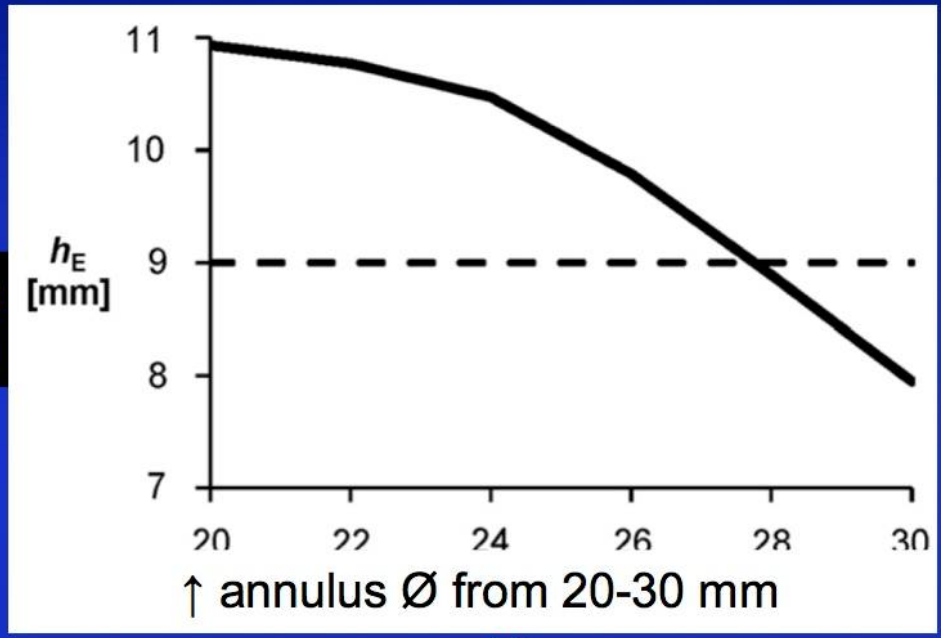
A new approach to the assessment of aortic cusp geometry

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

Parameters for valve coaptation



cH= 4-5 mm
eH= >9 mm



gH

Bicuspid : nonfused 24±2 mm

Tricuspid :
NC : 21±2 / LC : 20±2 / RC 20±2

↓ eH from 10.9 to 8.0 mm

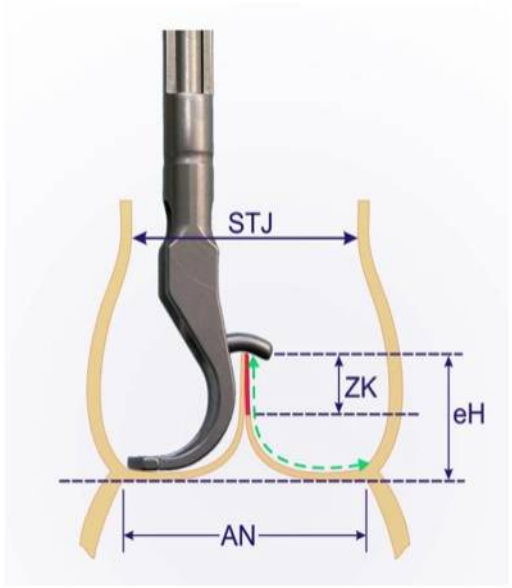
↓ cH from 3.3 to 0.3 mm

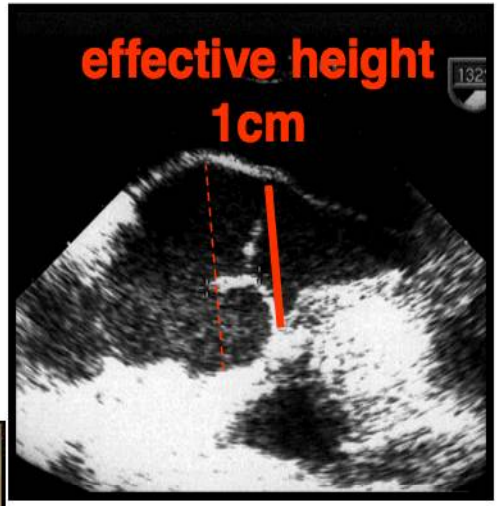
Correlates with body height, weight, BSA, sinus Ø, aortoventricular Ø

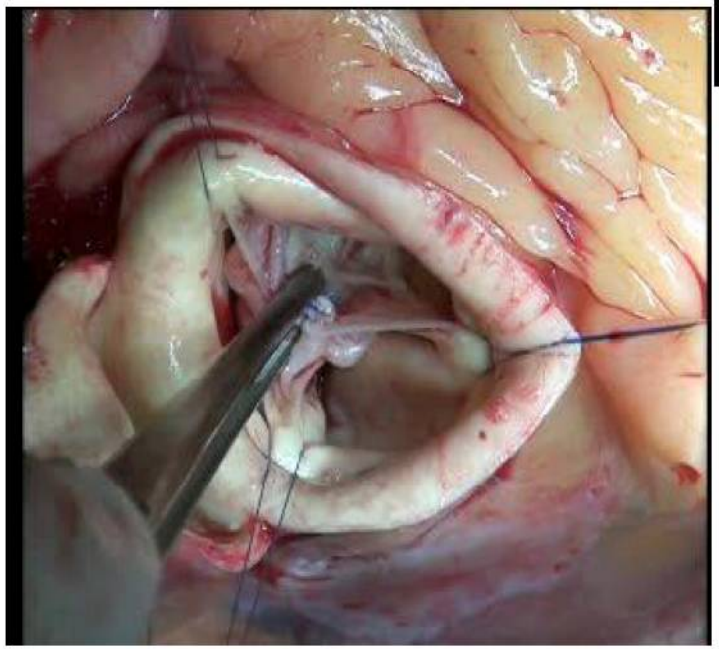
Tamas JHVD 2007 Bierbach EJTCVS 2010

Schäfers JTCVS 2012 Marom JTCVS 2012

Cusp Configuration

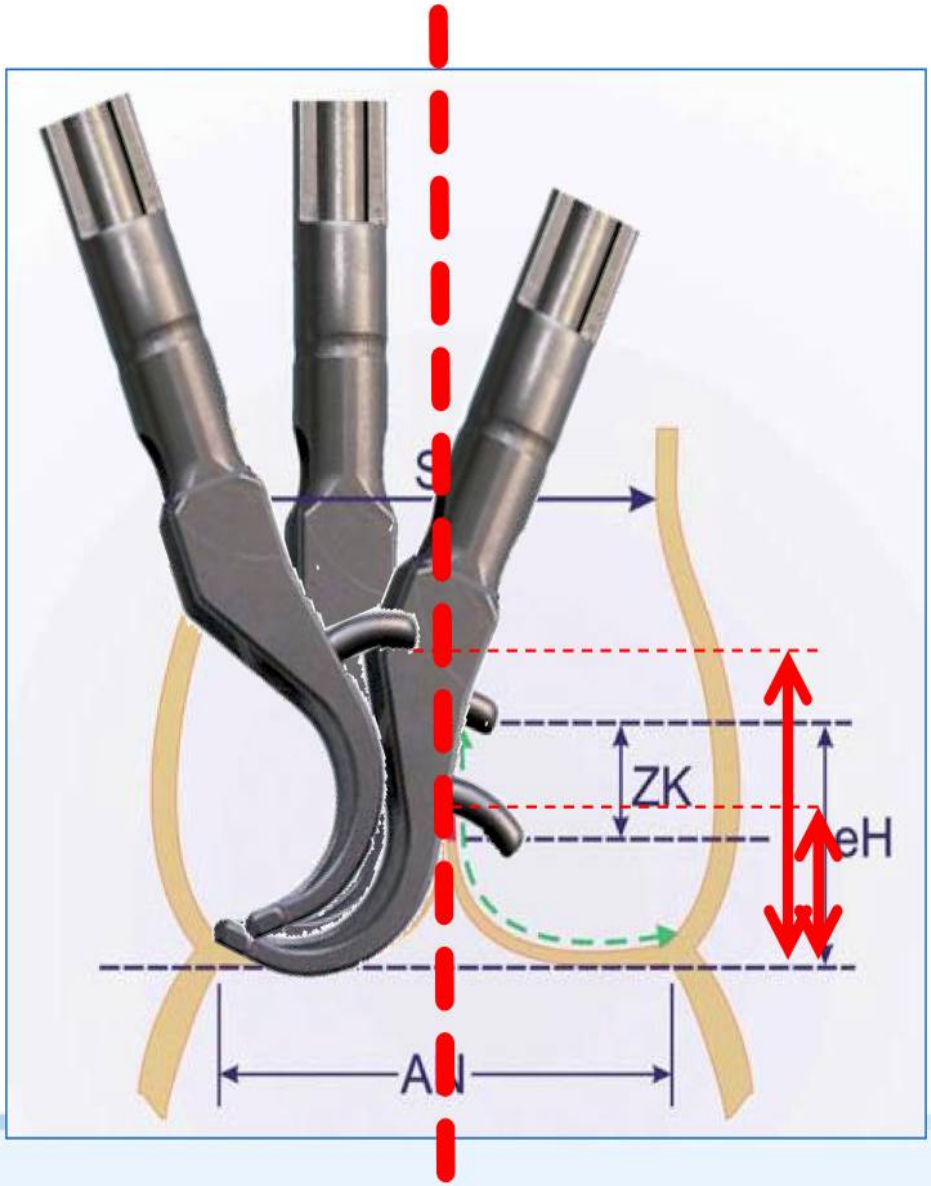


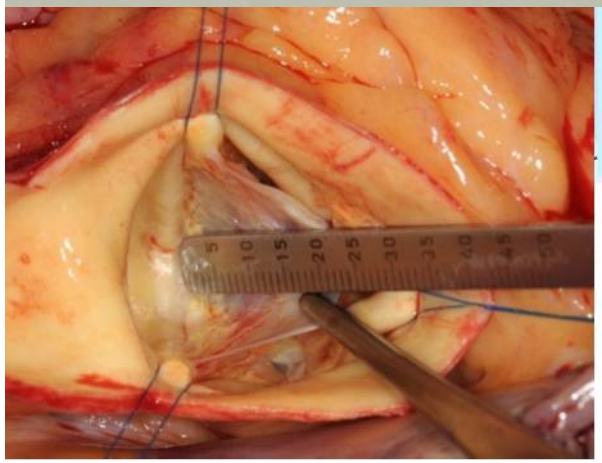




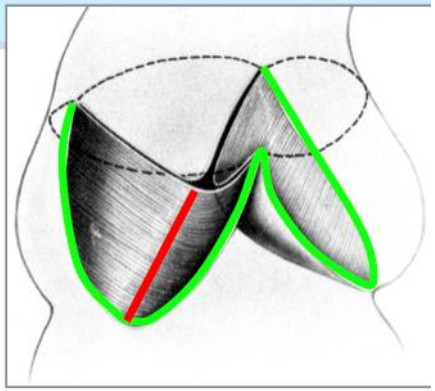
Schäfers HJ et al, JTCVS 2006

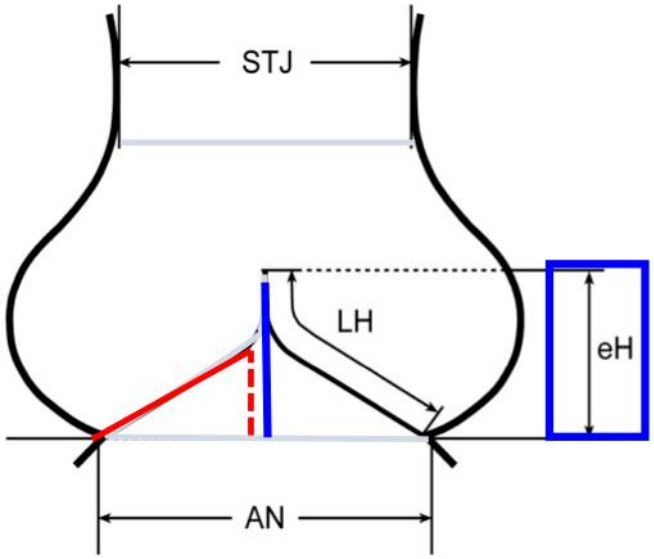
eH Measurement Error





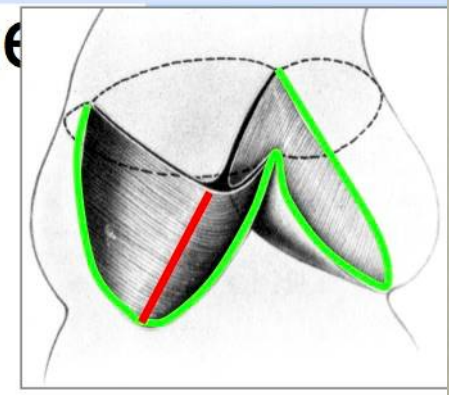
Configuration of cusps





Aortic Valve Repair - Assessme

Solutions



Configuration/coaptation of cusps

Cusp height in aortic valve

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

Objectives: Successful aortic valve rep
available on the normal dimensions of

Methods: The cusp height was measure
A tricuspid anatomy was present in 329
height, weight, preoperative degree of a
analyzed for possible interrelation betw

Results: In the bicuspid valves, the geon
± 2.0). Significant correlations were fo
valves, the height of the noncoronary c
left coronary cusp varied from 12 to 25
to 25 mm (mean, 20.0 ± 2.1). The nonco
cusp ($P = .000$). No difference was fou
between the geometric height and clini
degree of aortic regurgitation.

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

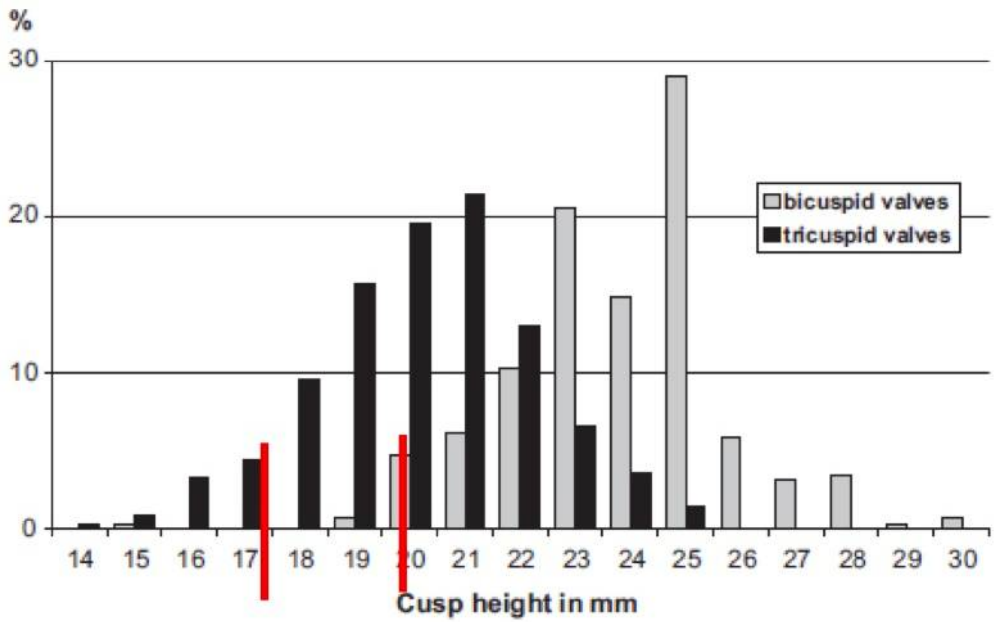
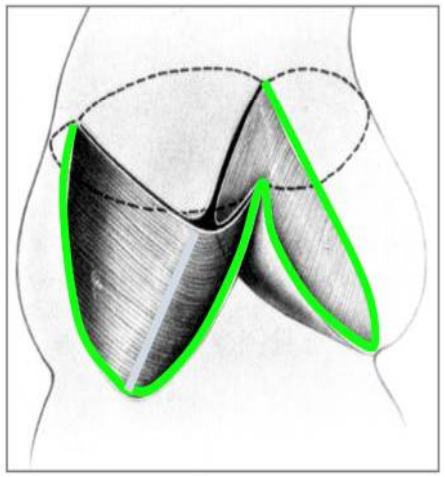


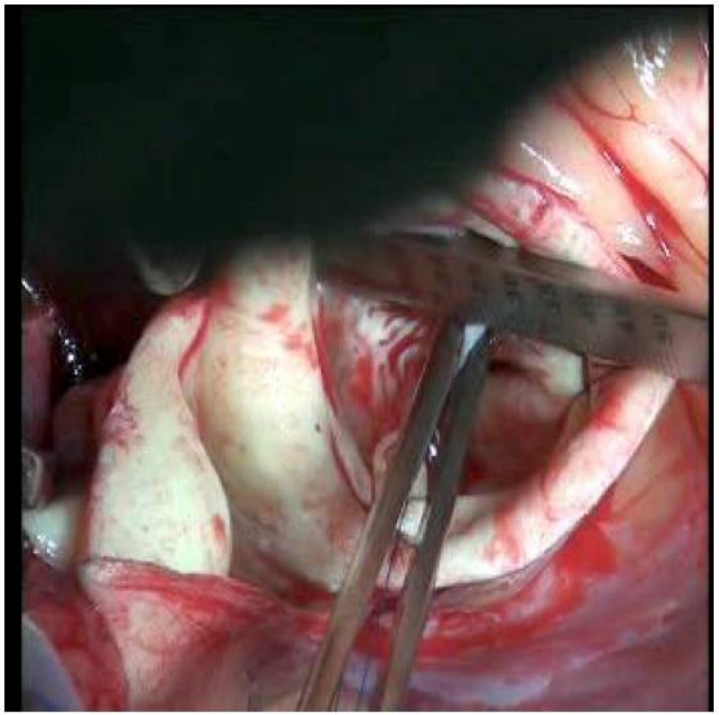
FIGURE 3. Distribution of geometric height in bicuspid (n = 289; nonfused cusps) and tricuspid (n = 332; mean of all 3 cusps) aortic valves.

Aortic Valve Repair - Assessment

Configuration/coaptation of cusps



TAV: 17-22 mm
BAV: 20-25 mm



Goals for aortic valve repair

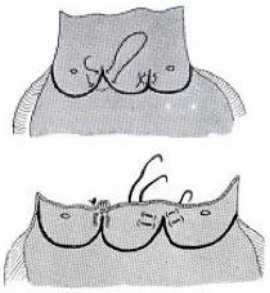
treat dilated aortic annulus and STJ Ø

preserve root dynamics (neosinuses of Valsalva)

preserve expansibility (interleaflet triangles)

restore coaptation and effective height

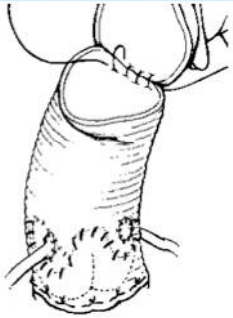
Taylor
1958



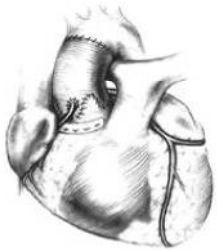
Cabrol
1966

Yacoub
1983

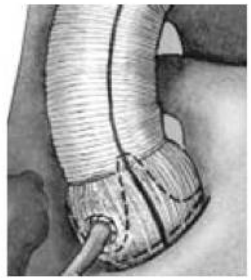
Carpentier
1983



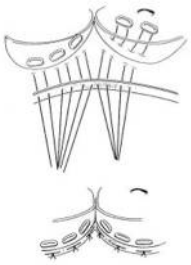
David
1992



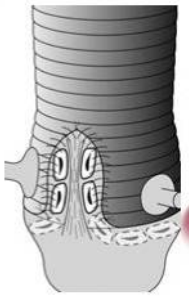
David III
1996



De Paulis
2001-2002



Izumoto
2002



Rankin
2011

Need for standardization

Αντικατάσταση της Αορτικής Ρίζας

Root Correction

If

Sinus > 40 -45 mm

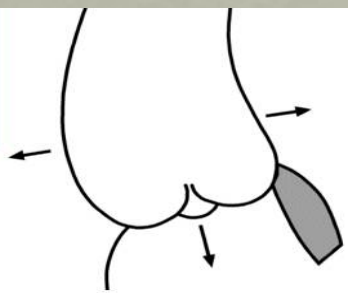
Root remodeling
(Valve reimplantation)

Sinus < 40-45

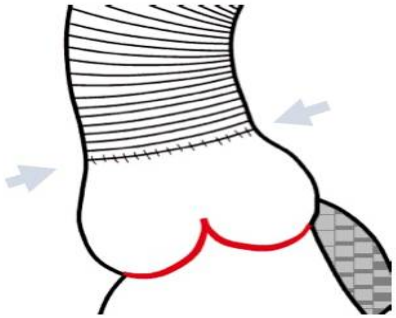
STJ remodeling

Τεχνικές Επιδιόρθωσης Αορτικής Ρίζας

Root Repair – Technical Options

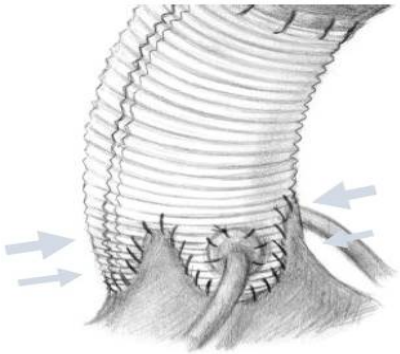


ST Junction Remodelling



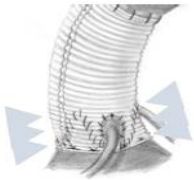
(Frater 1986)
(Sinus < 40-45 mm)

Root Remodeling



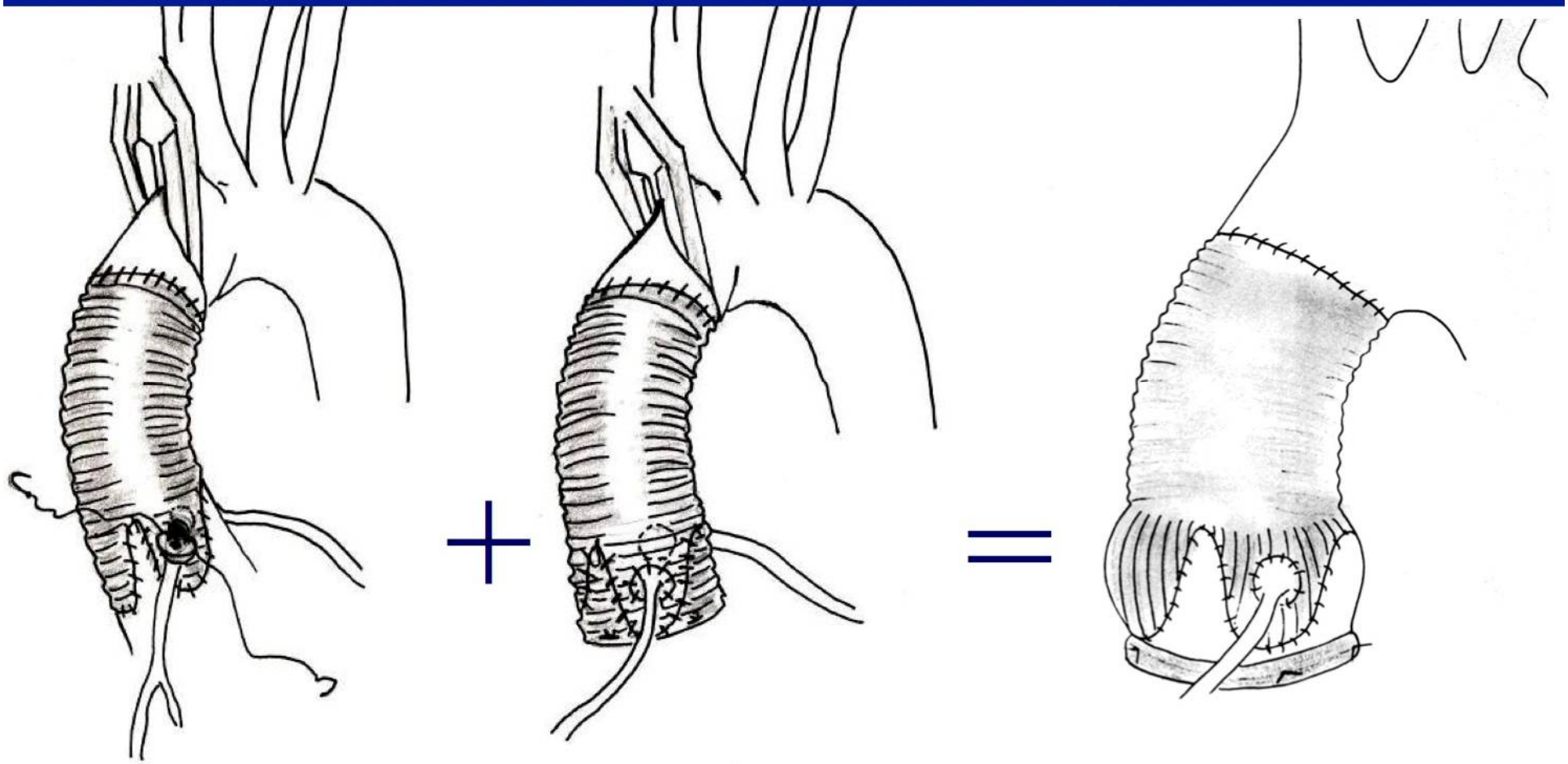
(Yacoub 1993)
(Sinus > 45 mm),

Reimplantation of Aortic Valve



(David 1992)
(AVJ ≥ 30 mm)

Physiological and standardized approach to Valve Sparing Root Replacement

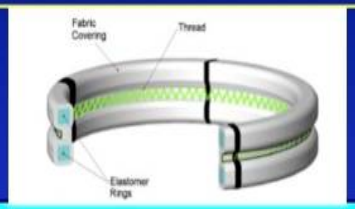


Remodeling more physiologic
RF failure annulus > 25 mm

Remodeling + subvalvular annuloplasty

TAoVSRR –Τεχνική

Standardization based on aortic annulus Ø

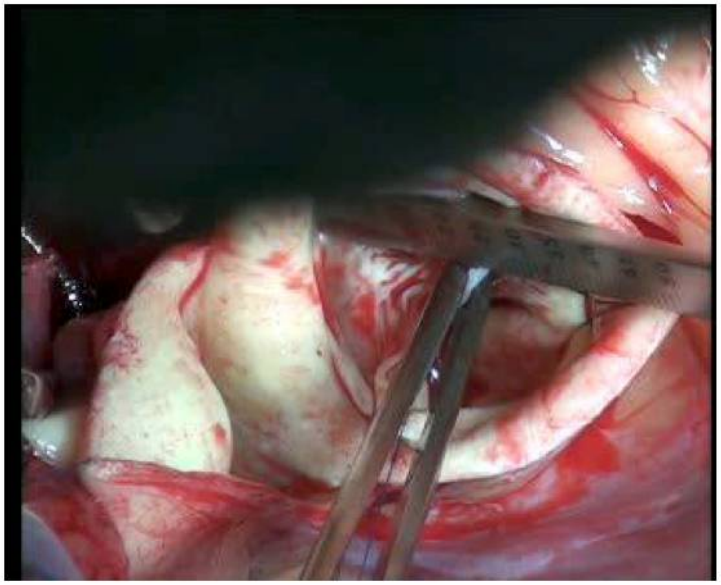


	Aortic annular base Ø (Hegar dilators, mm)				
	25-27	28-30	31-35	36-40	> 40
Valsalva graft® Ø (mm)	26	28	30	32	34
Extra aortic ring® Ø (mm)	25	27	29	31	33

Subvalvular ring = down size from one size

Διατήρηση της AoV-Πως γίνεται πρακτικά

Valve Sparing:



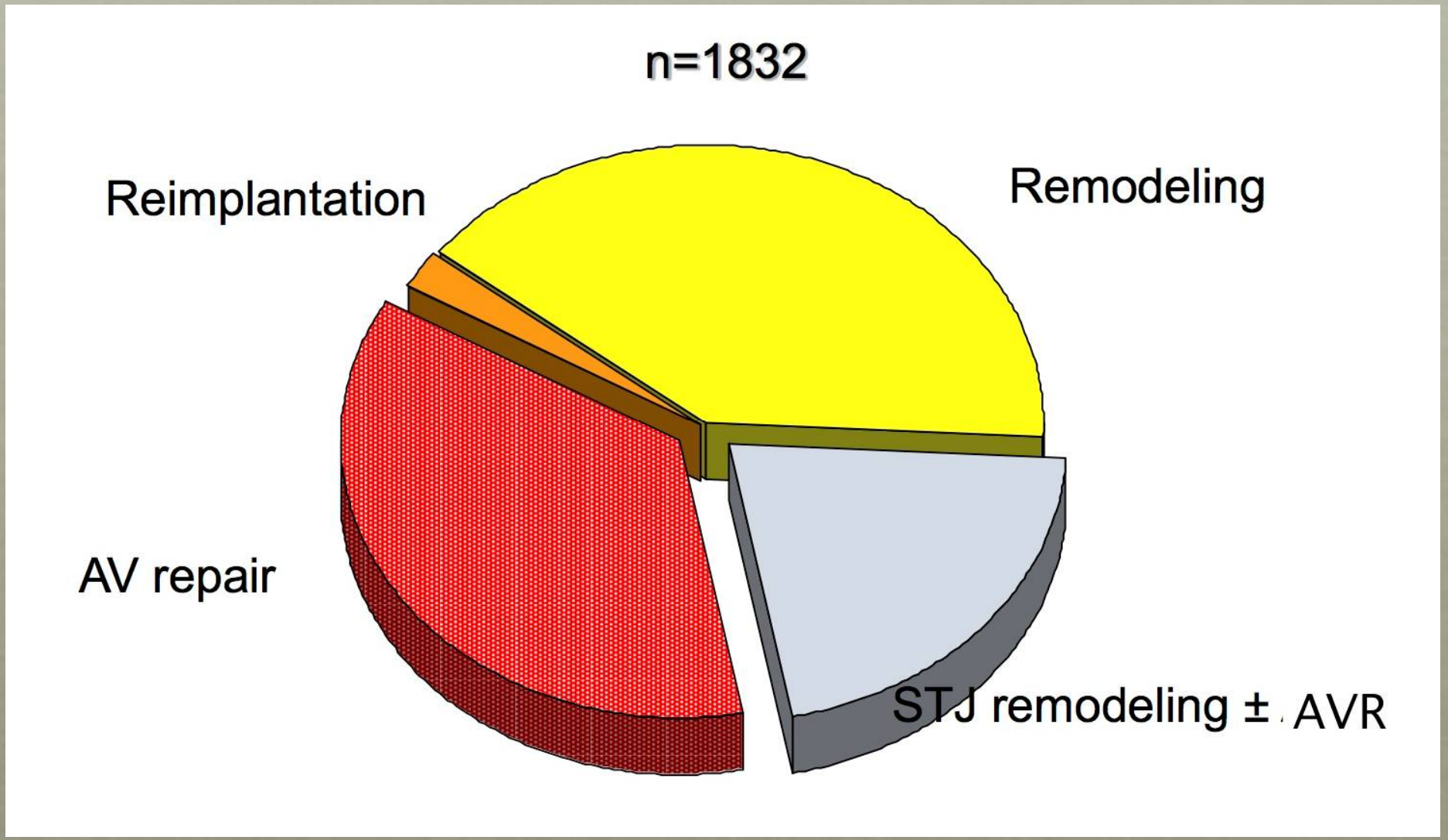
1. Measure gH and proceed with VPS if gH ≥ 18 mm

2. (Root remodeling) Take graft according to patient size

BSA	< 1.8 m²	24 mm
	1.8 to 2.2 m²	26 mm
	>2.2 m²	28 mm (?)

if gH ≤ 20 mm consider graft 1 size less

Aortic Valve Repair



Causes of Cusp Pathology

H.-J. Schäfers

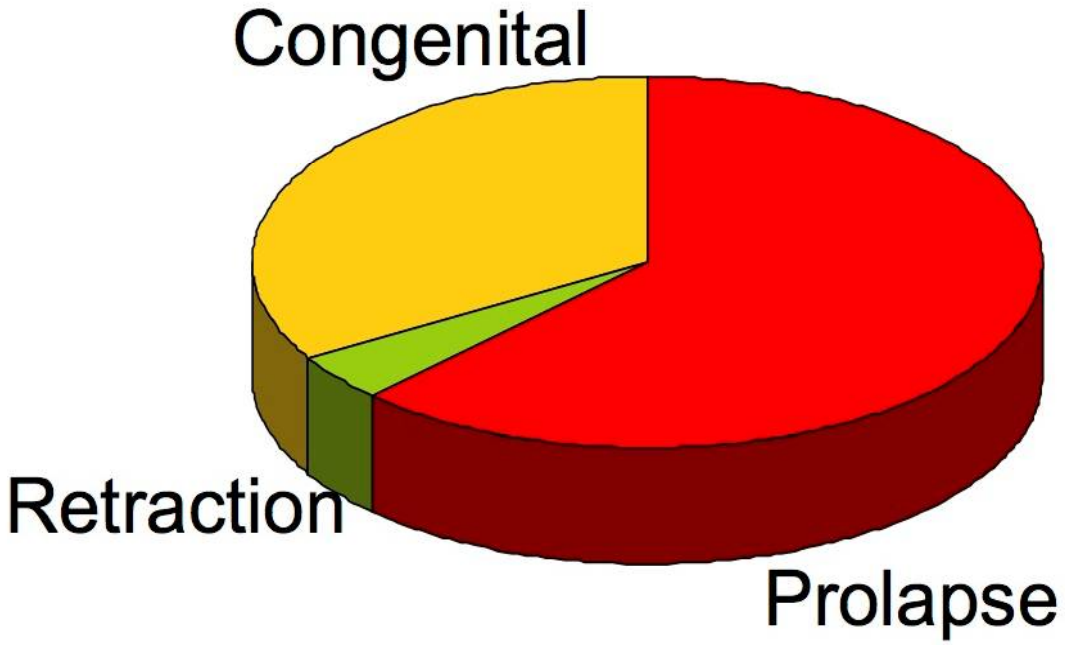
Prolapse n=606/826 =73%

(right > non > left-coronary cusp)

Congenital malformation

- bicuspid n=276
- unicuspid n =50
- quadricuspid n =3

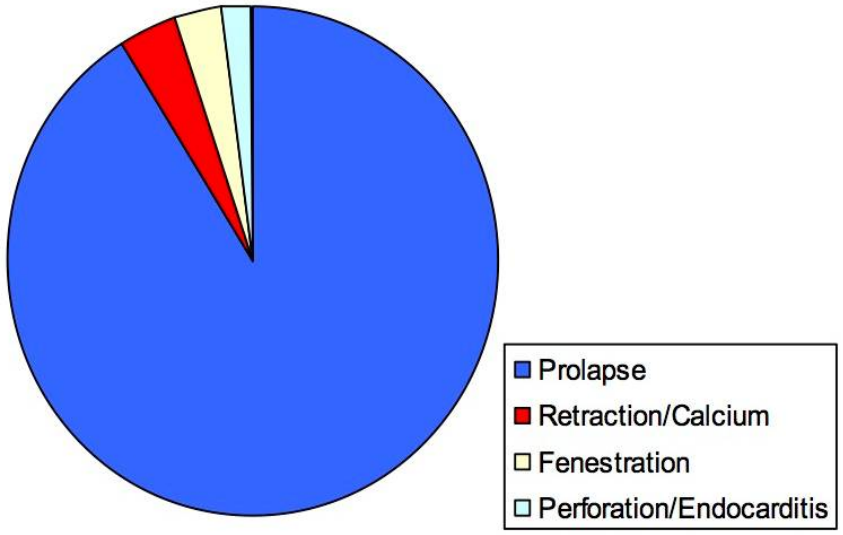
Retraction / Calcium n=42



Αίτια Ανεπάρκειας AoV (Γλωχίνες)

Causes of Cusp Alterations

Prolapse	91%
(right > non > left-coronary cusp)	
Retraction / Calcium	4%
Fenestration	3%
Perforation/Endocarditis	2%



Cusp Correction

If

- prolapse (eH ≤ 8 mm)
- structural defect
- anatomical variant

Plication of free margin / triangular resection

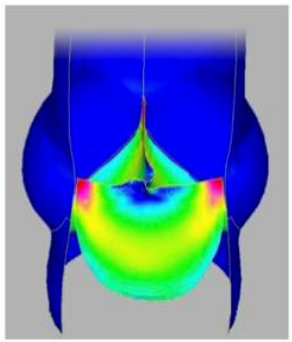
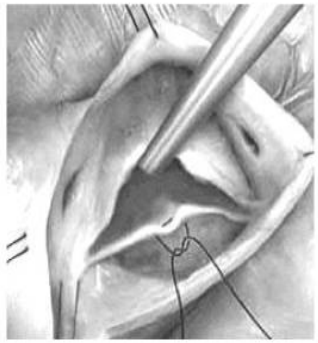
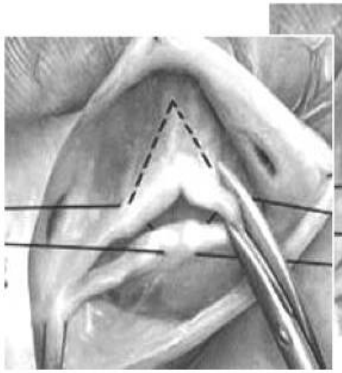
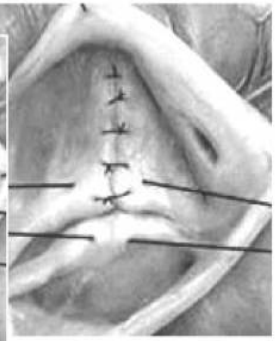
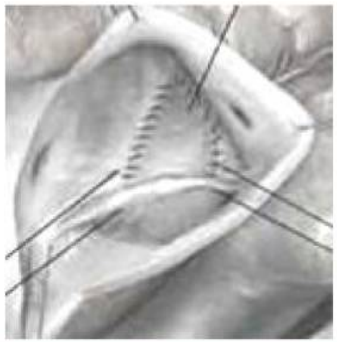
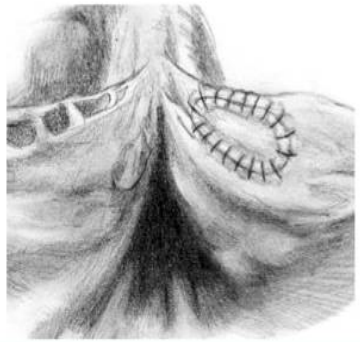
Patch correction

Conversion of anatomy (BAV, TAV constant)

- UAV ▶ BAV
- QAV ▶ TAV

Cusp Repair: Prolapse Techniques

Prolapse	Central Cusp Plication
Prolapse + Redundancy/ Fibrosis	Triangular Resection
Prolapse + Calcium/ Fenestrations	Pericardial Patch

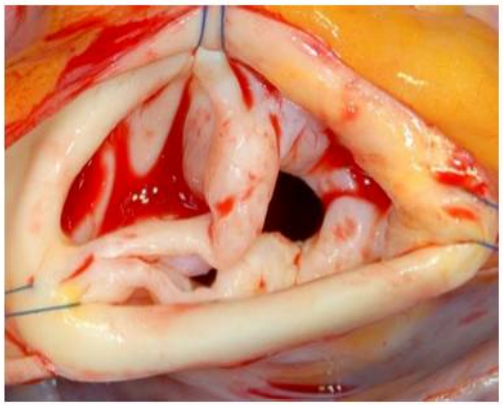







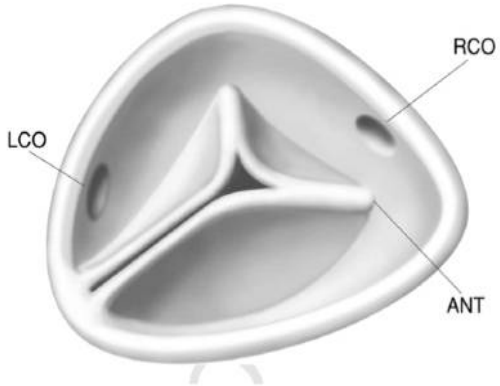
Aortic Valve Anatomy

Morphology	Incidence	Mean Age of Failure
Unicuspid	< 1%	20s
Bicuspid	2%	60s
Tricuspid	97 %(?)	?
Quadricuspid	< 1 %	40s

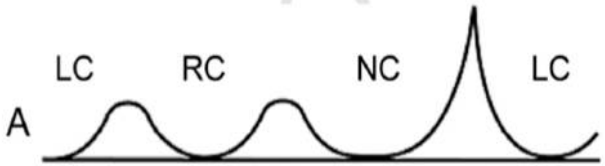
Roberts WC, Circulation

Bicuspidization of the Unicuspid Aortic Valve

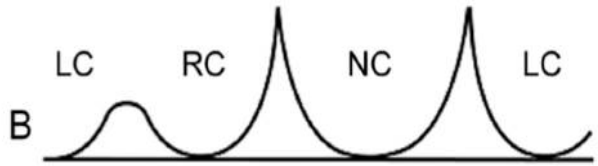




unicuspid

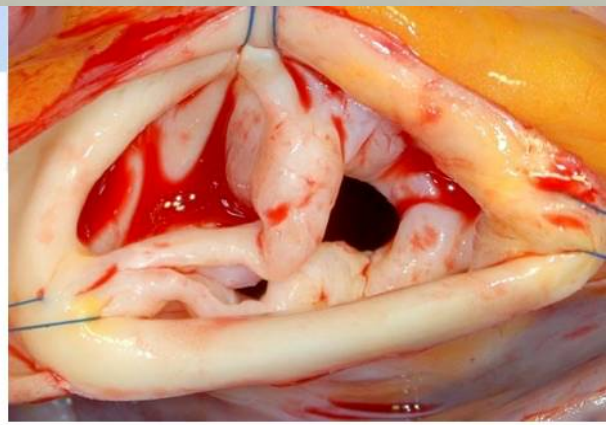


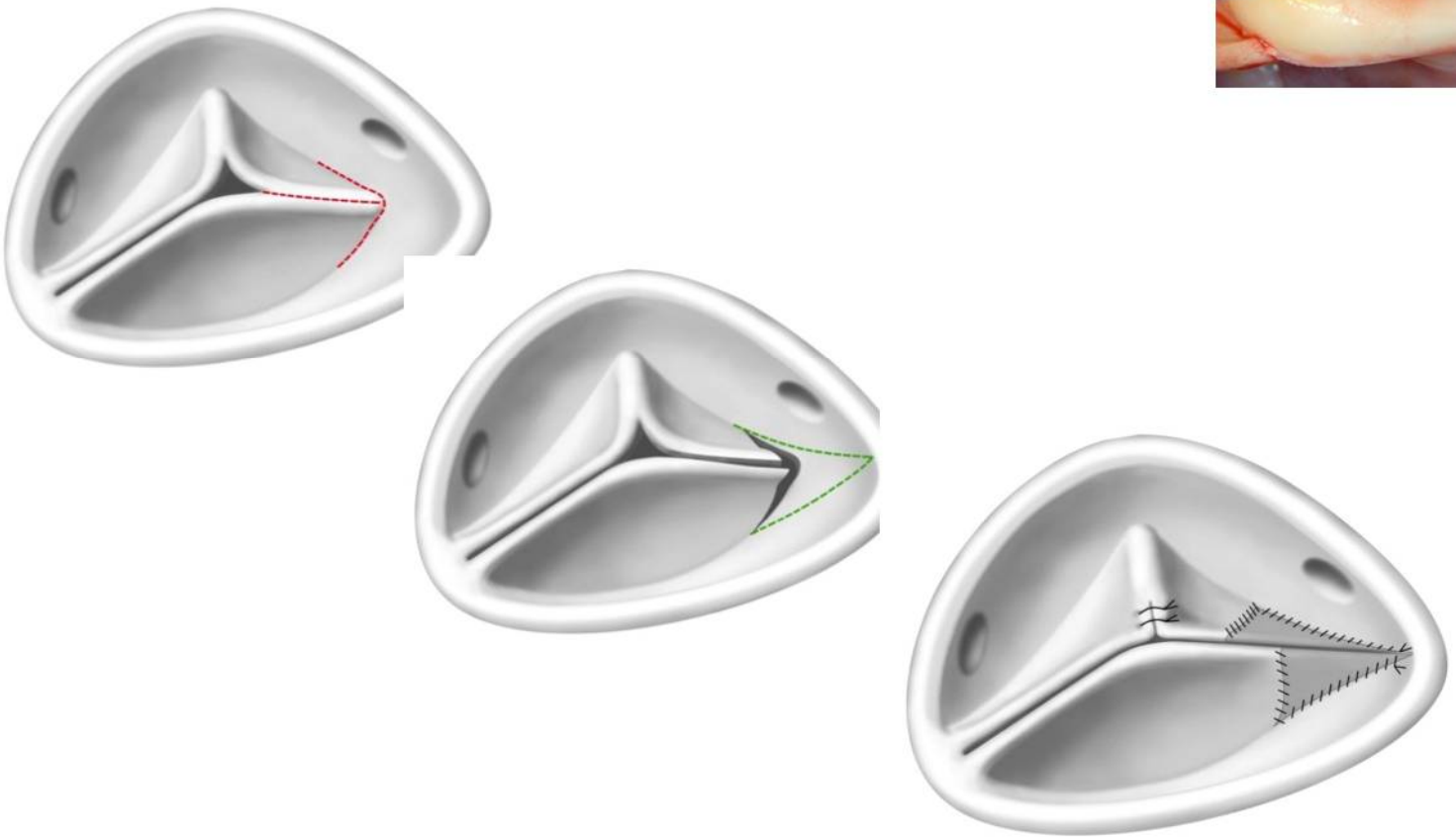
bicuspid



Anderson RA, JHVD 2001

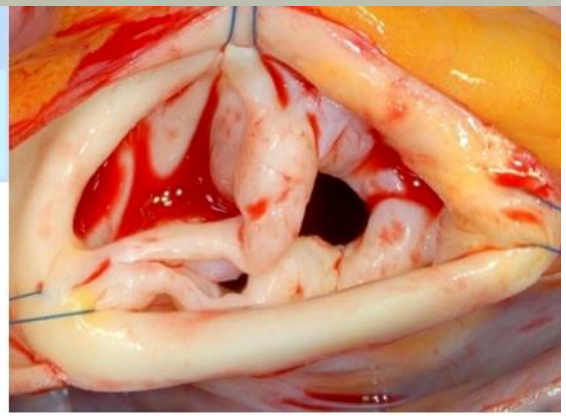
Bicuspidization of the Unicuspid Aortic Valve





Schäfers HJ, ATS 2008

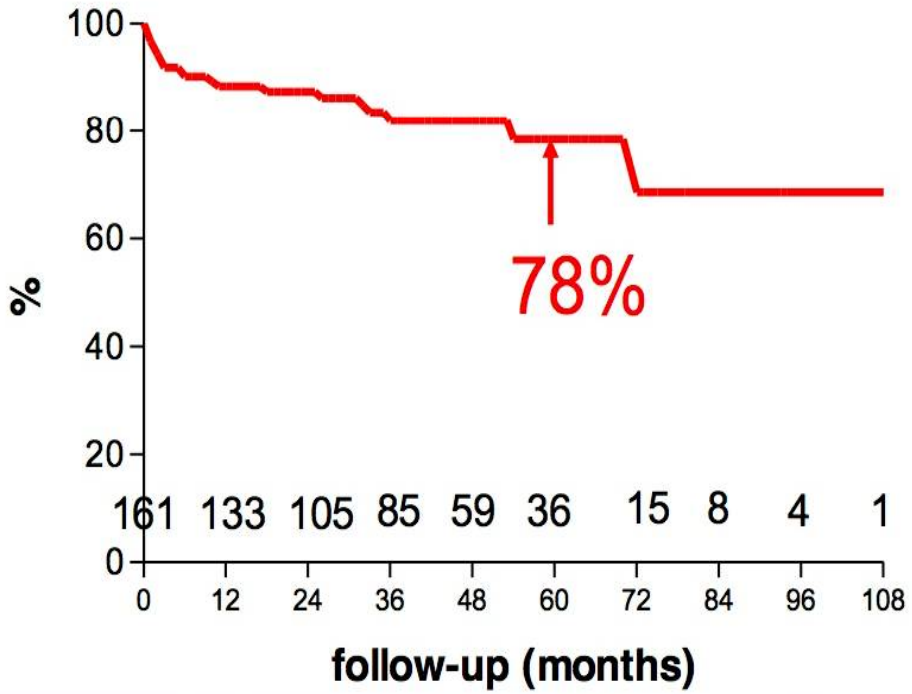
Bicuspidization of the Unicuspid Aortic Valve II



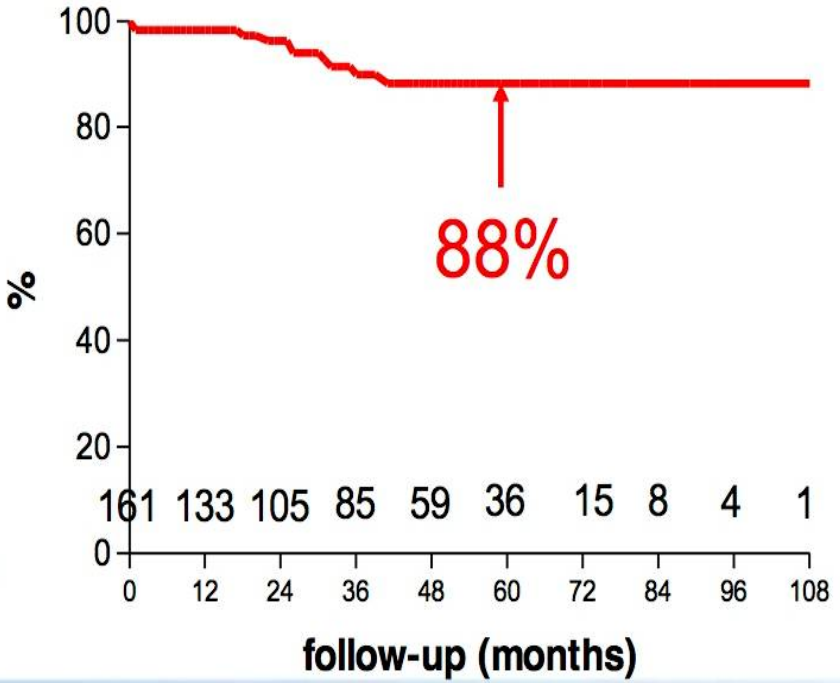
Unicuspid aortic valve repair (n=161)

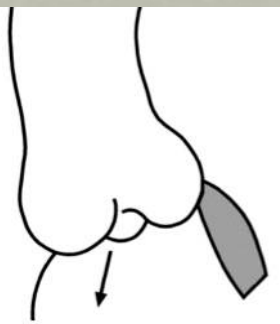
n= 27 remodeling
n= 35 STJ remodelling
n= 99 isolated aortic valve repair

Freedom from Reoperation:



Freedom from Valve Replacement:

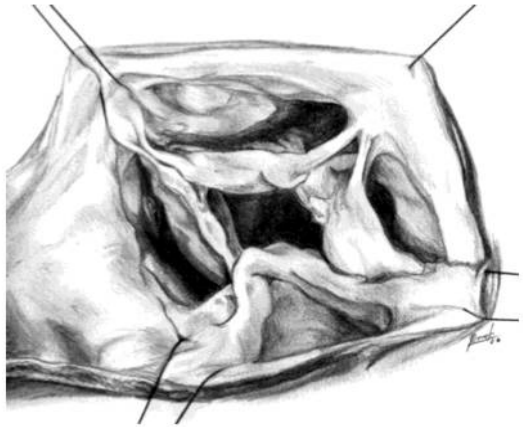




Reconstructive Techniques

Cusp Pathology

Anomaly



Conversion of configuration

Quadricuspid AV

Schmidt et al., Ann Thorac Surg 2007

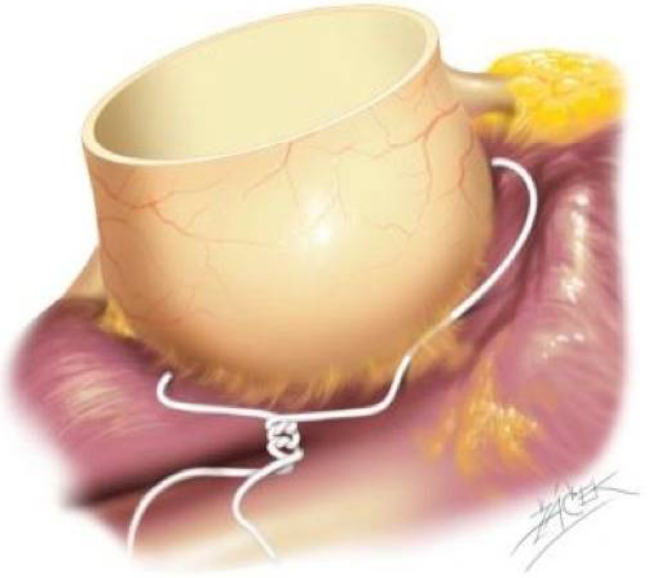
Annuloplasty

If

Basal diameter > 26-27 mm

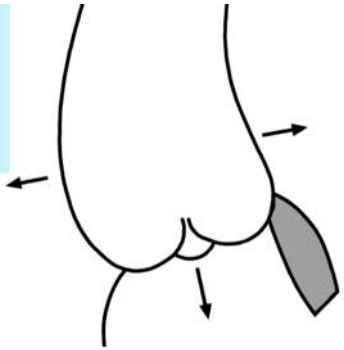
Annular reduction

- 25 mm for BSA > 2 m²
- 23 mm for BSA < 2 m²



Reduce by 2 mm for

gH < 19 (TAV) / 22 (BAV) mm

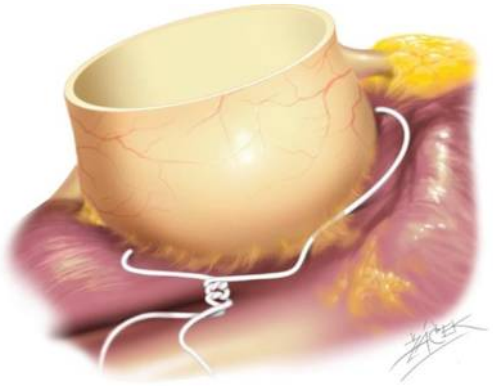


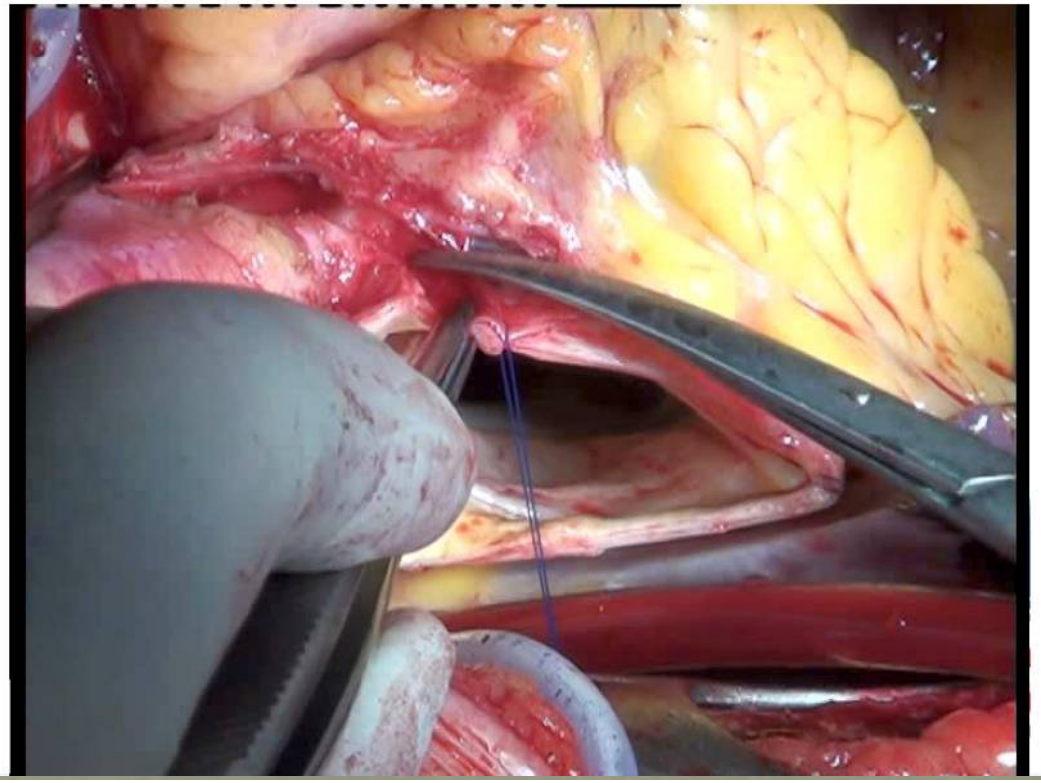
Repair – Technical Options

Subcommissural Plication

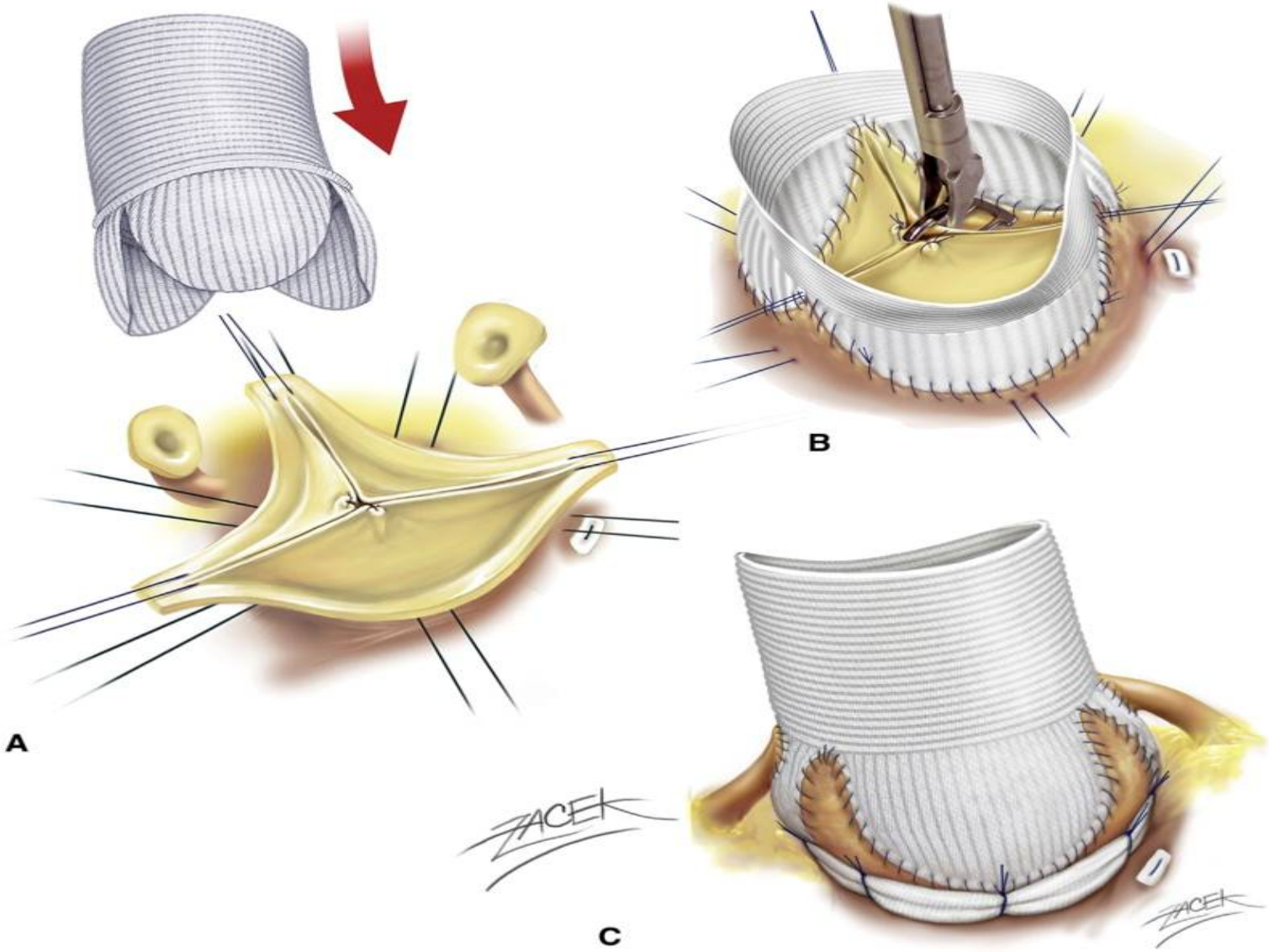
(Cabrol 196

Aortoventricular Stabilisation
(AVJ > 27mm)

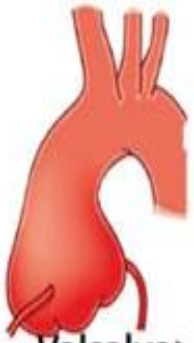




Standardized steps in remodeling of the aortic root associated with cusp effective height resuspension and external expansible subvalvular aortic ring annuloplasty *(Lansac et al/JTCS 2017)*

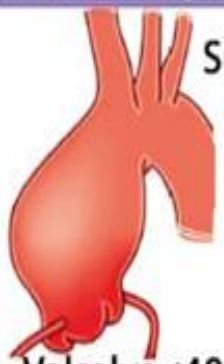


Pliable bicuspid and tricuspid valves: 232 patients



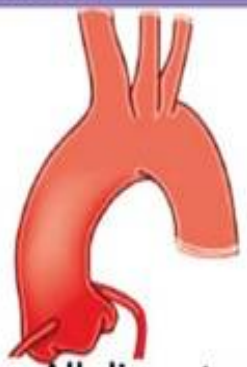
Aortic root aneurysm
149 patients

Valsalva> 45 mm



Supracoronary aorta aneurysm
21 patients

Valsalva<40 mm



Isolated aortic insufficiency
62 patients

All diameters<40 mm

Standardized approach according to phenotypes

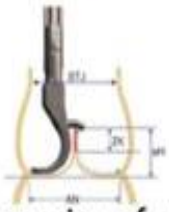
Remodeling
+
subvalvular annuloplasty

Supracoronary graft
+
subvalvular annuloplasty
(annulus>25 mm)

Double sub- and supra-valvular annuloplasty
(annulus>25 mm)

Cusp repair

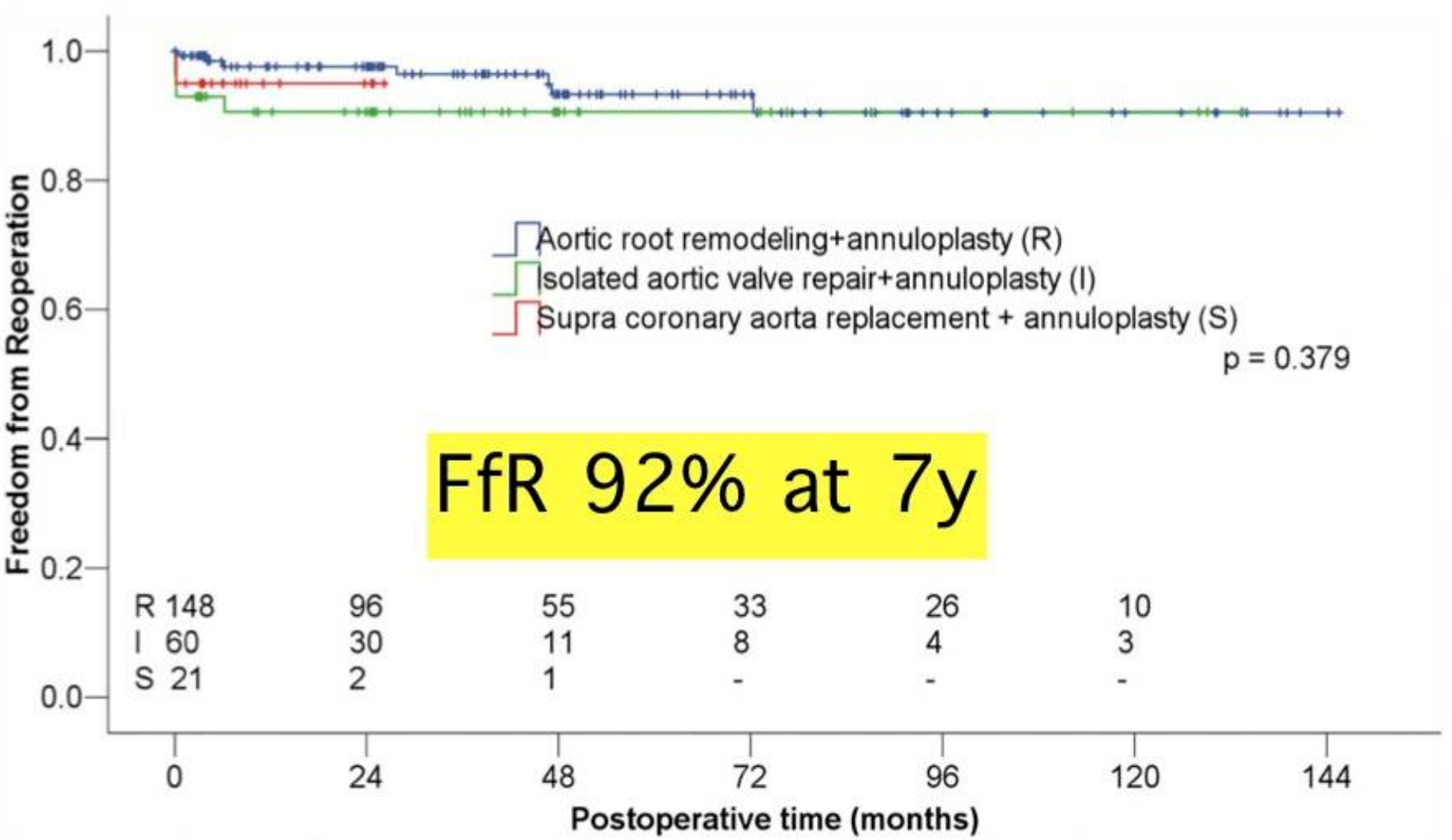
Alignment of the cusp free edges



Resuspension of cusp effective height

+

Subvalvular external aortic ring annuloplasty



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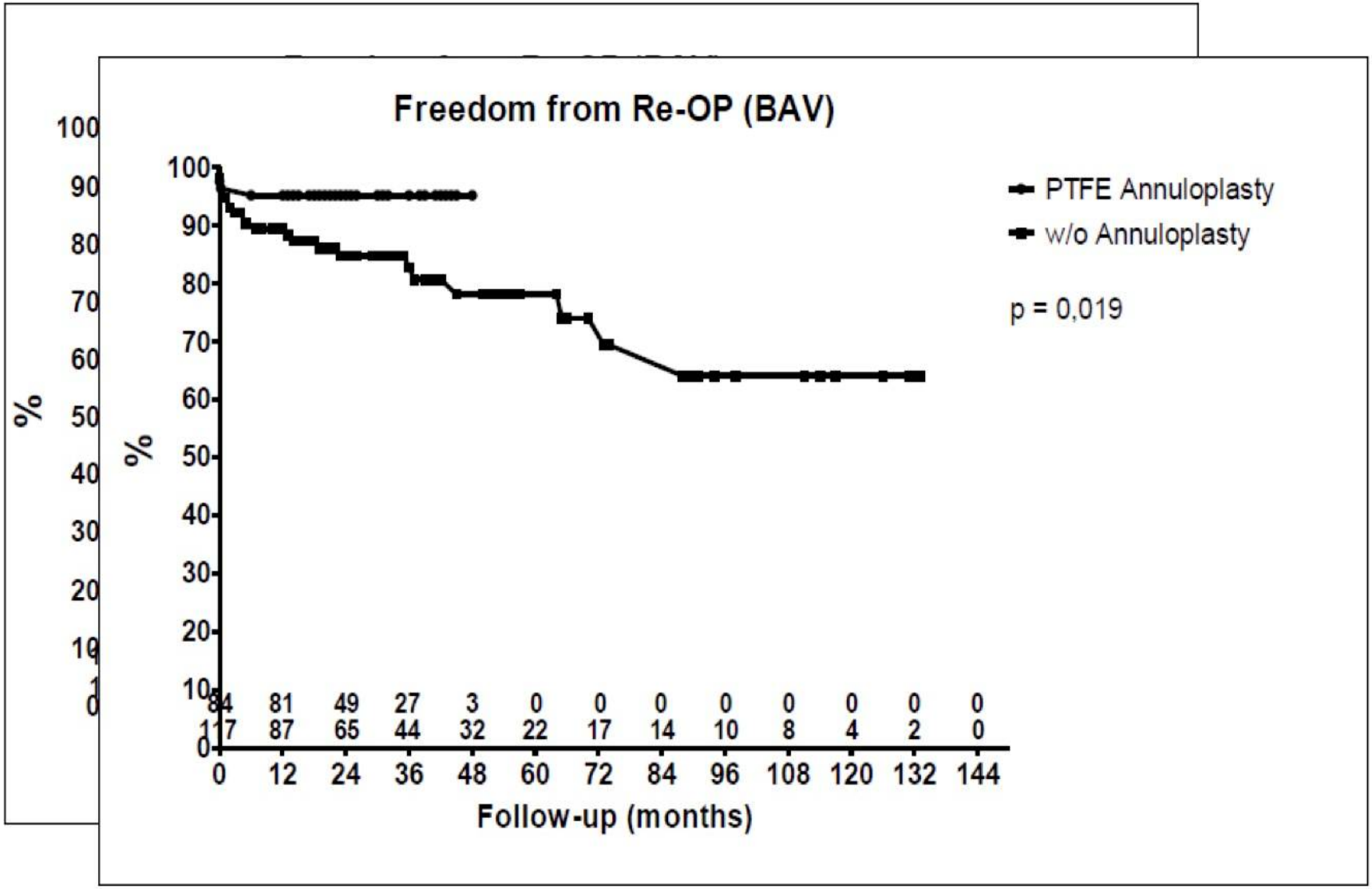
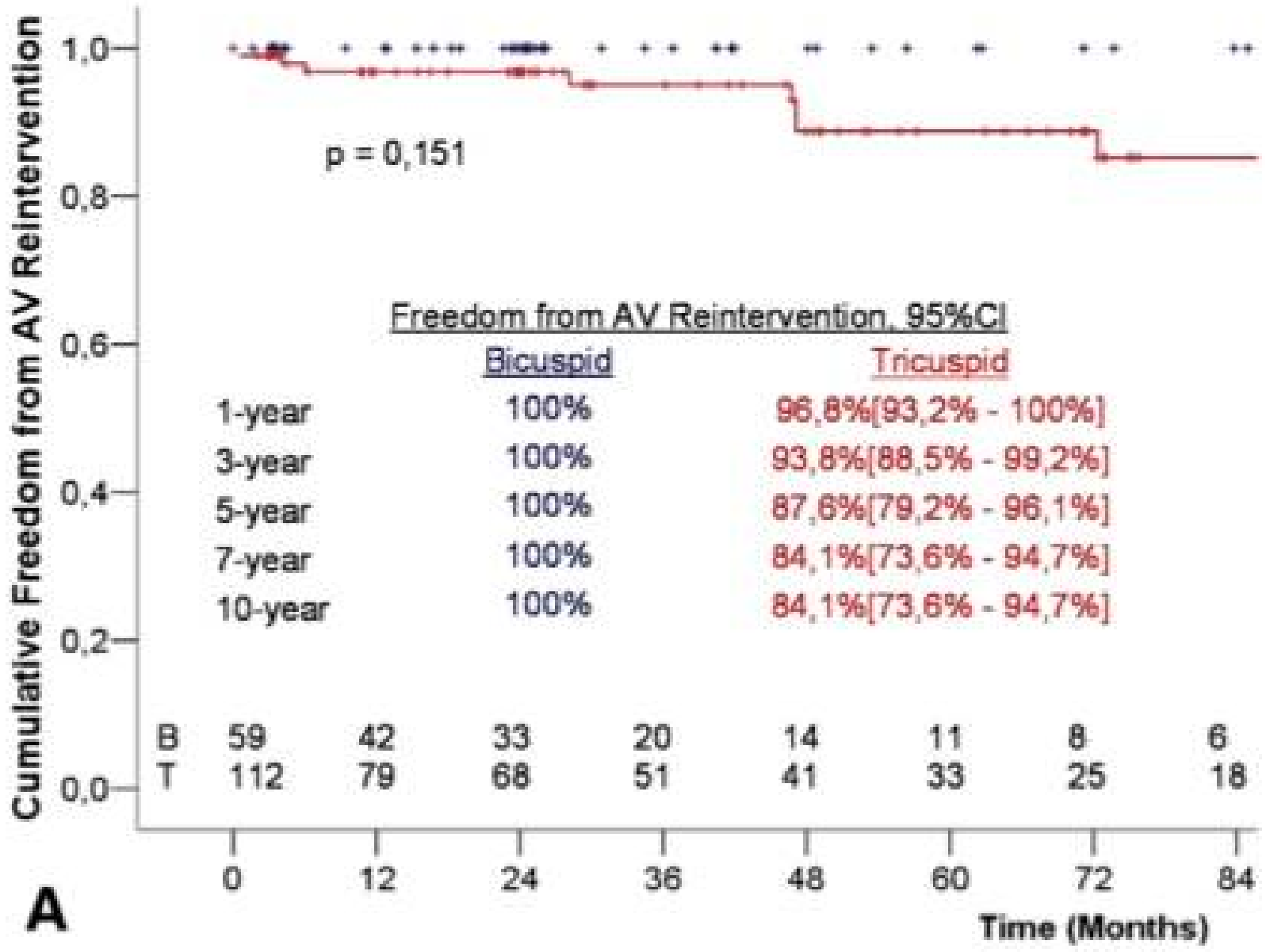
Long-term results of external aortic ring annuloplasty for aortic valve repair†

232 pts

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]


Freedom from Re-OP (BAV)
%
100
90
80
70
60
50
40
30
20
10
0
PTFE Annuloplasty
w/o Annuloplasty
p = 0,019
84 81 49 27 3 0 0 0 0 0 0 0 0
117 87 65 44 32 22 17 14 10 8 4 2 0
0 12 24 36 48 60 72 84 96 108 120 132 144
Follow-up (months)


Cumulative Freedom from AV Reintervention
1,0
0,8
0,6
0,4
0,2
0,0
p = 0,151
Freedom from AV Reintervention, 95%CI
Bicuspid
Tricuspid
1-year
100%
96,8%[93,2% - 100%]
3-year
100%
93,8%[88,5% - 99,2%]
5-year
100%
87,6%[79,2% - 96,1%]
7-year
100%
84,1%[73,6% - 94,7%]
10-year
100%
84,1%[73,6% - 94,7%]
B 59 42 33 20 14 11 8 6
T 112 79 68 51 41 33 25 18
0 12 24 36 48 60 72 84
Time (Months)
A

Standardized Aortic Valve Repair

1. No relevant calcification,
   geometric cusp height > 17-20 mm

Decision for valve preservation

2. Sinus diameter > 40 -45 mm
   (and /or BAV < 150° ?)

Root replacement

Standardized Aortic Valve Repair

3. If root + cusp necessary,

Root repair first (interaction between intercommissural distance and cusp configuration)

4. Annular stabilization (AI, durability)

5. Correction of cusp prolapse (eH)

Συμπεράσματα

- *Η AoV επιδιόρθωση οδεύει σε αναπαραγώγιμη τεχνική (τυποποίηση-στάδια)*
- *Η επιστημονική βάση της προοδευτικά αποσαφηνίζεται*
- *Οι επιπλοκές από την βαλβίδα είναι σπάνιες σε επιτυχή επιδιόρθωση*
- *Η AoV επιδιόρθωση έχει ένδειξη σε κάθε ασθενή με AoVR*

Aortic Valve Reconstruction