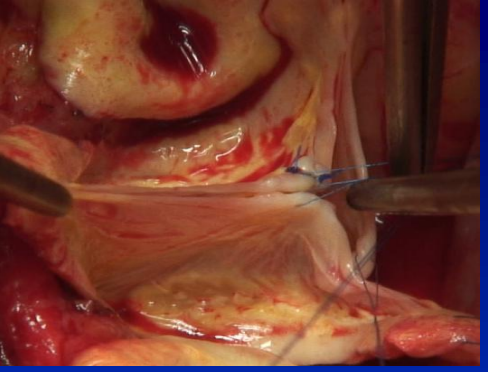
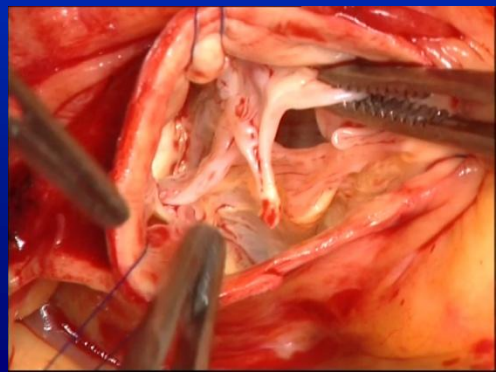


Towards a standardized and physiological approach to aortic valve repair

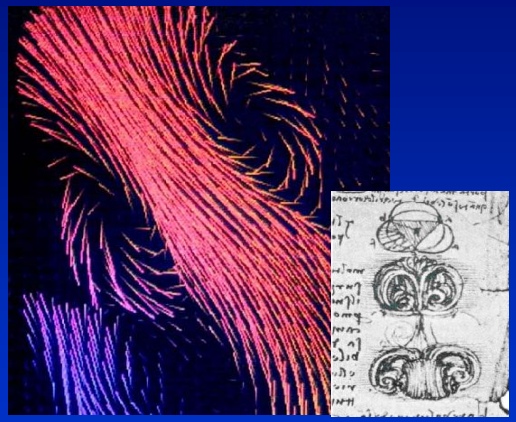
Emmanuel Lansac MD PhD

Cardiac Surgery
Institut Mutualiste Montsouris
Paris, France

AVIATOR

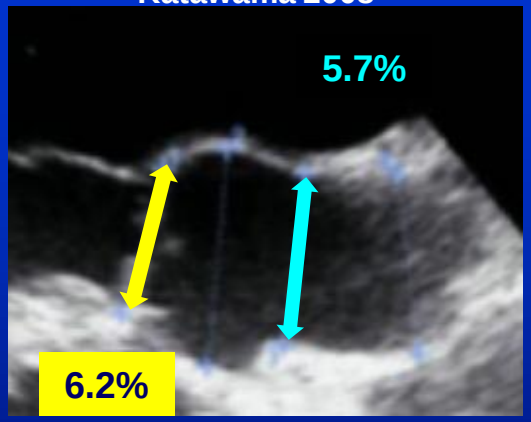


Dynamic anatomy of the aortic root



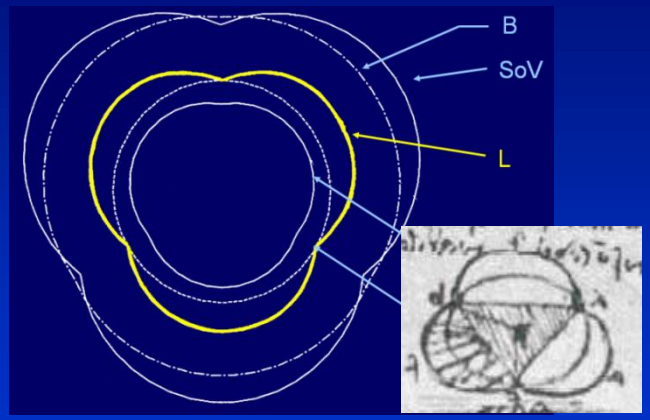
Vortices = stressless valve closure

Katawama 2008



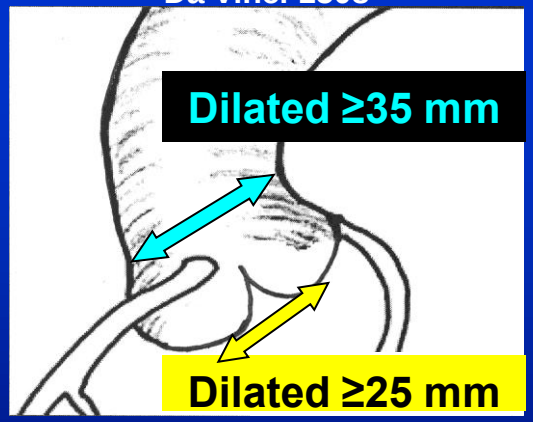
Aortic annulus and STJ expansion

7 series,
1999-2007: 183 patients



Clover shaped aortic valve orifice

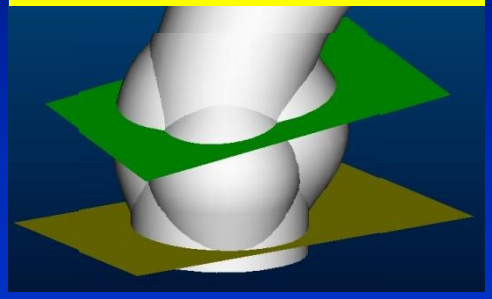
Da Vinci 1508



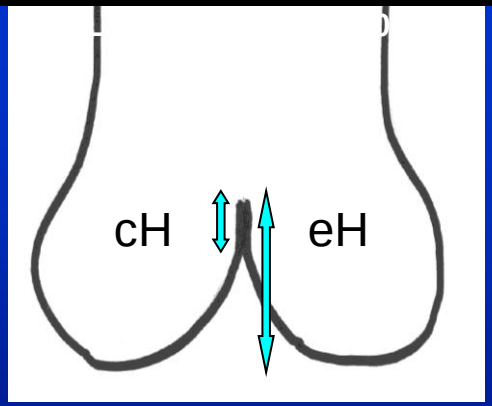
STJ > Annulus Ratio = 1.2 (1.1-1.3)

10 series,
1987-2009: 717 patients

Stressless opening of the aortic valve



Systolic expansion of root volume + 37.7 2.7%



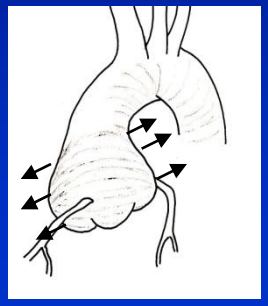
cH= 4-5 mm
eH= 9-10 mm

Schäfers JTCVS 2006
Tamas JHVD 2007

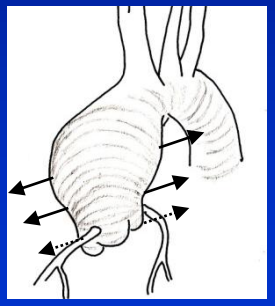
Guidelines 2012 / AHA 2014

Aneurysm

Aortic root



Supra-coronary



Symptoms

Ø ≥ 55 mm tricuspid or bicuspid valves

Ø ≥ 50 mm bicuspid,
If risk factors: coarctation, HTA, family history

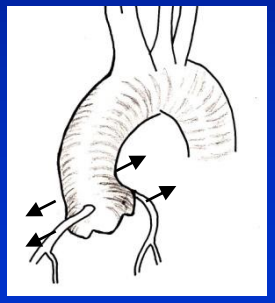
Ø ≥ 50 mm Marfan
45 mm if hight risk or pregnancy

↑ ≥ 2 mm/yr

Ø ≥ 45 mm aortic valvulopathy

Ø ≥ 25 mm/m² Tuner syndrom

Isolated AI



Symptoms

Asymptomatic
and EF<50%

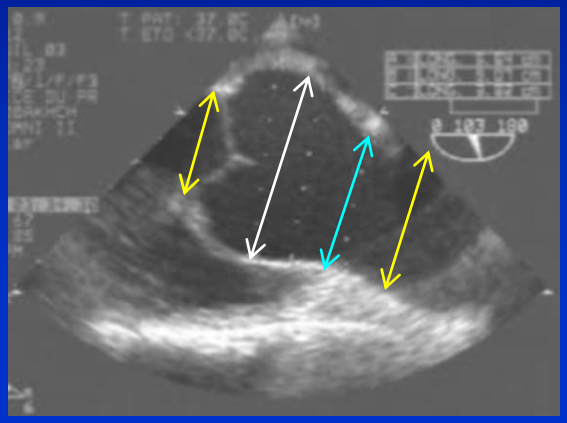
and/or LVSD> 50 mm (25 mm/m2)

et/ou LVDD>70 mm

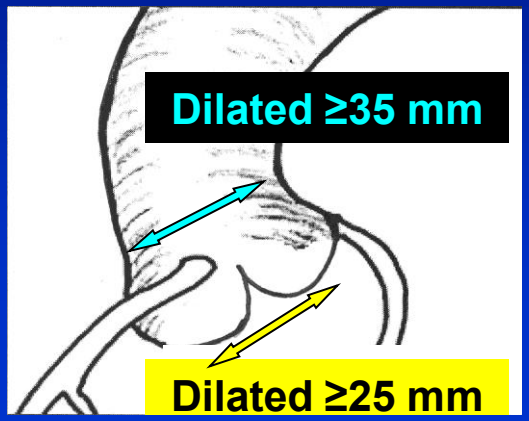
Guidelines : AHA/ACC Circulation 2008,
ACCF/AHA Circulation 2010, ESC Eur Heart J 2012

Pre operative TEE

4 diameters

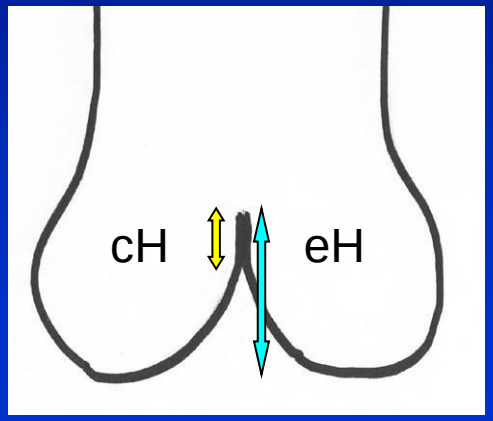


STJ > Annulus
Ratio = 1.2 (1.1-1.3)



cH= 4-5 mm

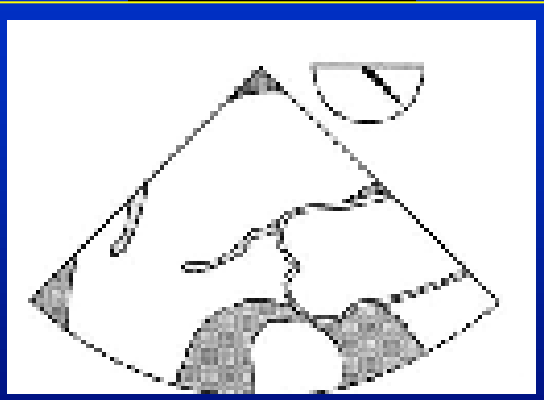
eH= 9-10 mm

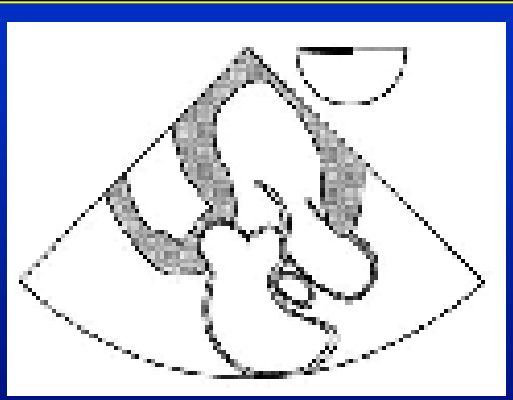


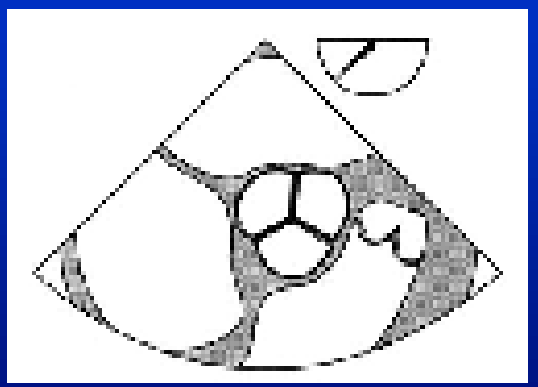
Long axis
120-140

Deep transgastric view
0 et 120

Short axis
45





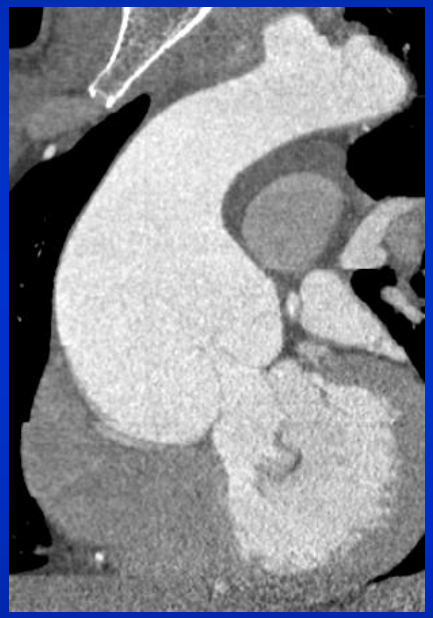


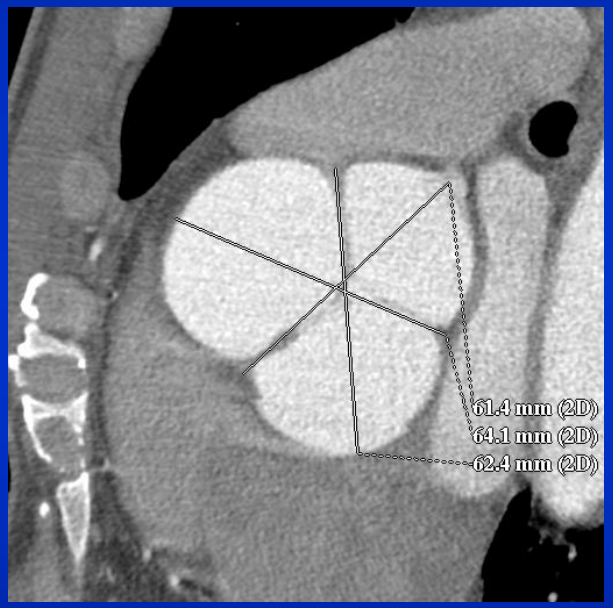
4 diameters **Coaptation** **Direction of the jet**

Number of cusps
Origin of the jet
Commissural analysis

Gated CT scan

Precise aortic measurement
Coronary analysis and ostia implantation
coaptation analysis, interleaflets triangles and bicuspid





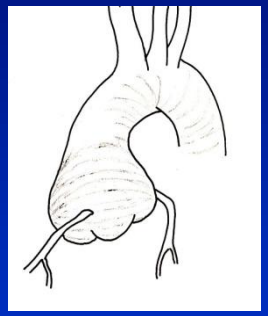
MRI

Not precise for aortic measurement
AI quantification
LV fonction and dilation
Bicuspid

Root phenotype

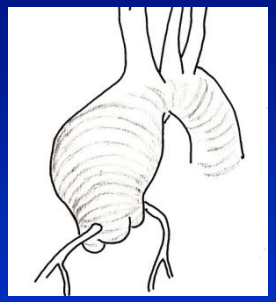
Root aneurysm

Valsalva ≥45 mm



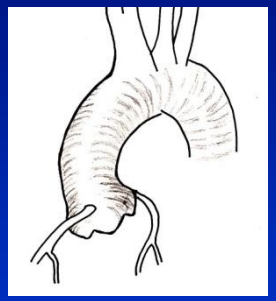
Supra coronary aneurysm

Valsalva ≤ 40 mm



Isolated AI

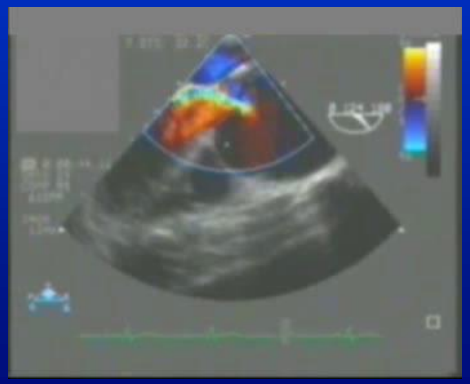
All Ø ≤ 40 mm



Cusp motion

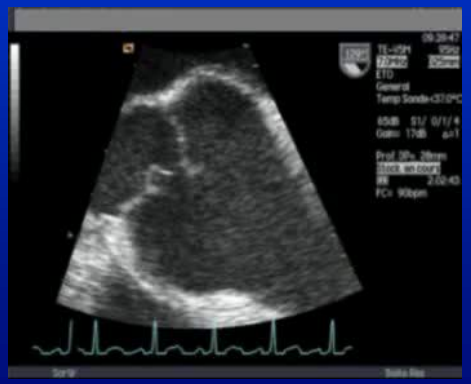
Normal (I)

AI zero
Central jet



Prolaps (II)

Eccentric jet



Retracted (III)

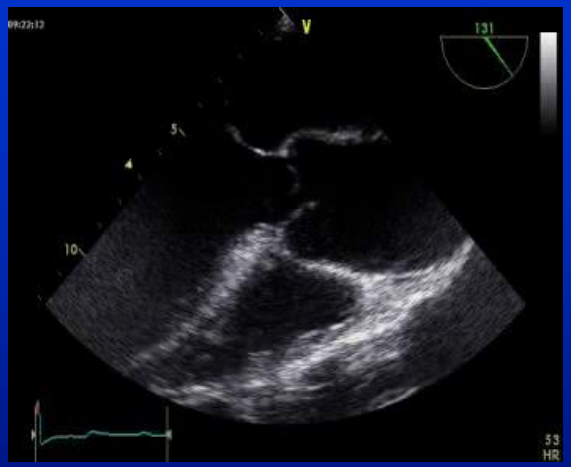
Carpentier A. JTCVS 1983, El Khoury et al curr opin cardiol 2005, Lansac et al EJCTS 2008

Prolapsus

Direction du jet

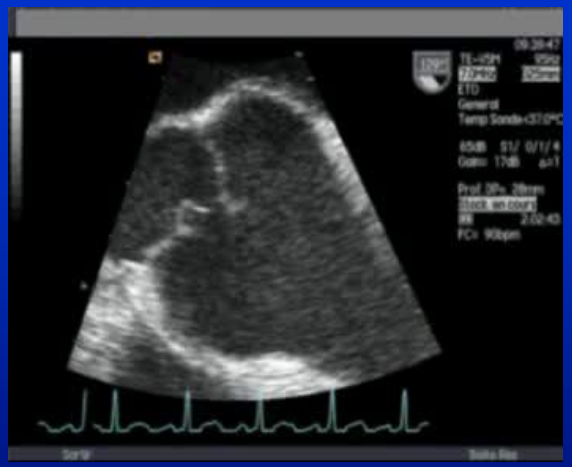
Excentré vers le septum

Prolapsus NC ou CG



Excentré vers la valve mitrale

Prolaps CD



Current knowledge

9 cohort studies 1999-2010

4713 patients (mean age 50 years)

Langley 1999	Aomi 2002	Byrne 2003	Pacini 2003	Settepani 2005	Radu 2007	Kalkat 2007	Mataraci 2009	Etz 2010

Survival 62 to 84.5% at 10 years

Bentall versus réparation

7 études de cohorte 2001-2010

930 patients (âge moyen 43 ans)

Bassano 2001	de Oliveira 2003	Karck 2004	Zehr 2004	Patel 2008	Volguina 2009	Franke 2010

	Valve repair	Mechanical Bentall
Reoperation	2.4%/an	1.7%/an
TE	1.0%/an	5.4%/an
Hemoragic	Only 2 patients	1.4%/an

Quality of life: Bentall vs repair

Incidences of serious adverse events (Death, stroke, TE, Reop) :
Bentall 28.3% vs repair 10.8% (*p 0.008)*

Quality of live (SF 36) compromise in relation to all criteria outlined in the 36 items
Bentall vs Plastie p<0.007

Patients severely disturbed by valve noise
Bentall 40% vs repair 4.9%

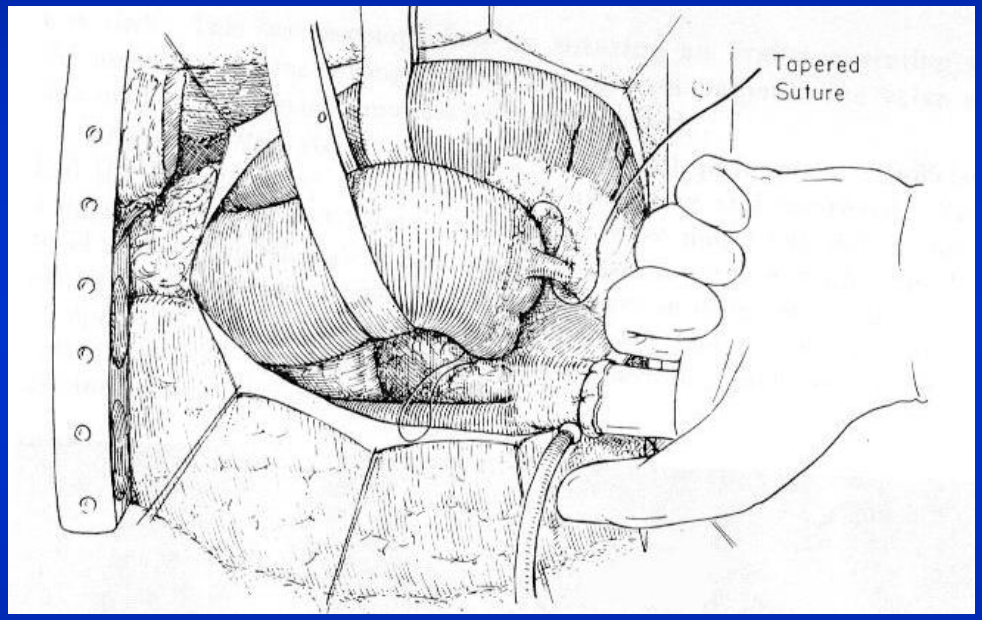
Patients afraid of valve failure
Bentall 50% vs repair 22.4%

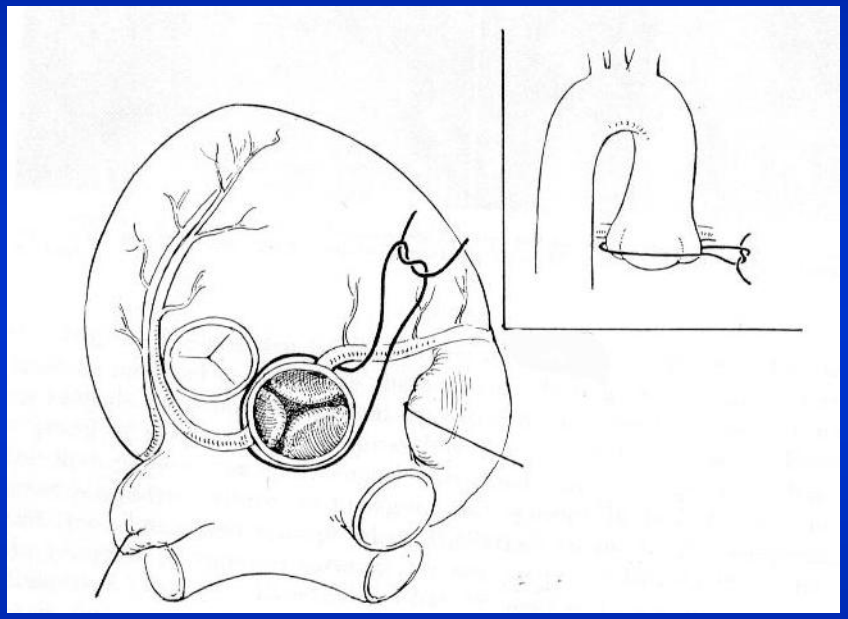
Self evaluation of patient overall conditions
Bentall 5.8/10 vs repair 7.8/10

Franke. ATS 2010

The surgical correction of aortic insufficiency by circumclusion

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



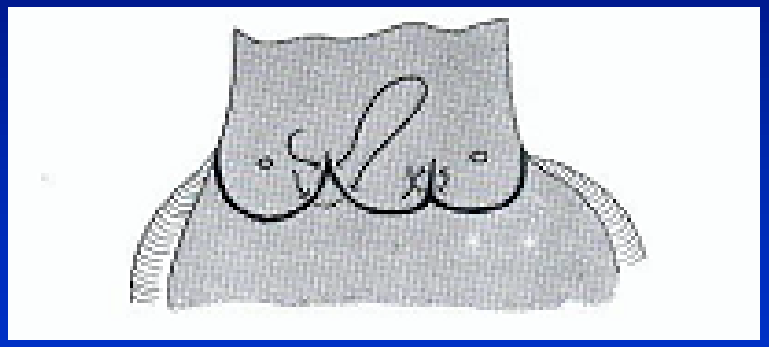


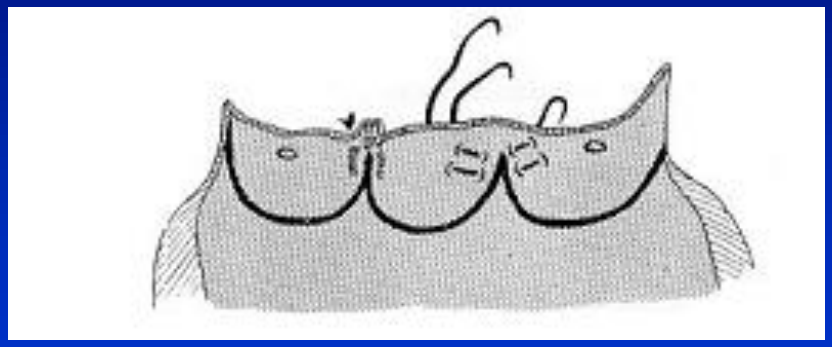
First subvalvular aortic annuloplasty

Beating Heart Right thoracotomy

11 patients, rheumatic disease (8/11)

Subcommissural plication stitches
(Cabrol stitches-1966)





Plicating U stitches at the base of the interleaflet triangles

= partial subvalvular annuloplasty

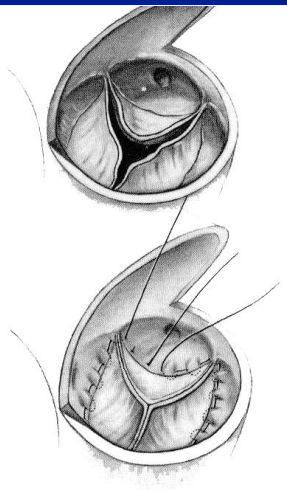
Plicating U stitches at the commissures

= partial supravalvular annuloplasty

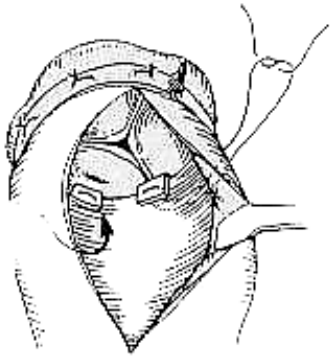
Plication of the interleaflet triangles impairing valve dynamics
especially for bicuspid valves ⟹ significant gradient
minimal reduction in aortic annular base diameter

Useful to protect a commissural repair or as a bailout technique

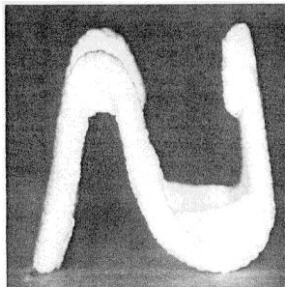
Aortic annuloplasty devices and techniques



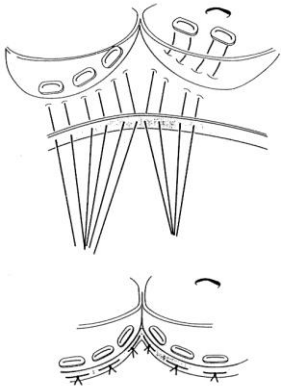
Carpentier
1983



Frater
1986

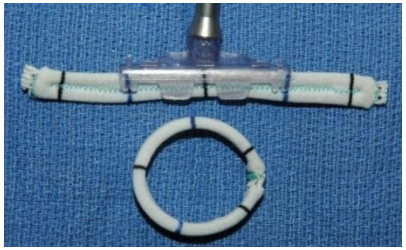


Duran
1986

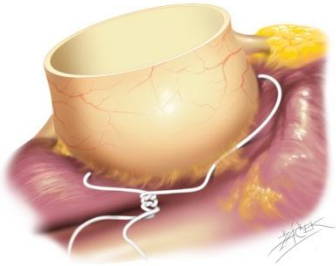


Izumoto
2002

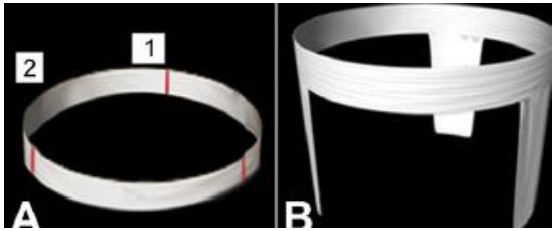
Hahm
2006



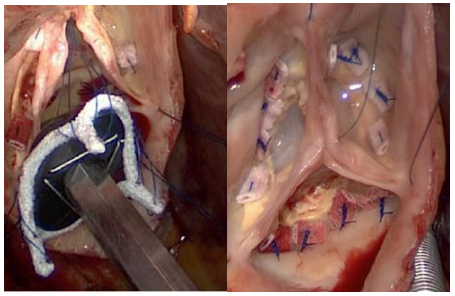
Lansac
2007



Schäfers
2009



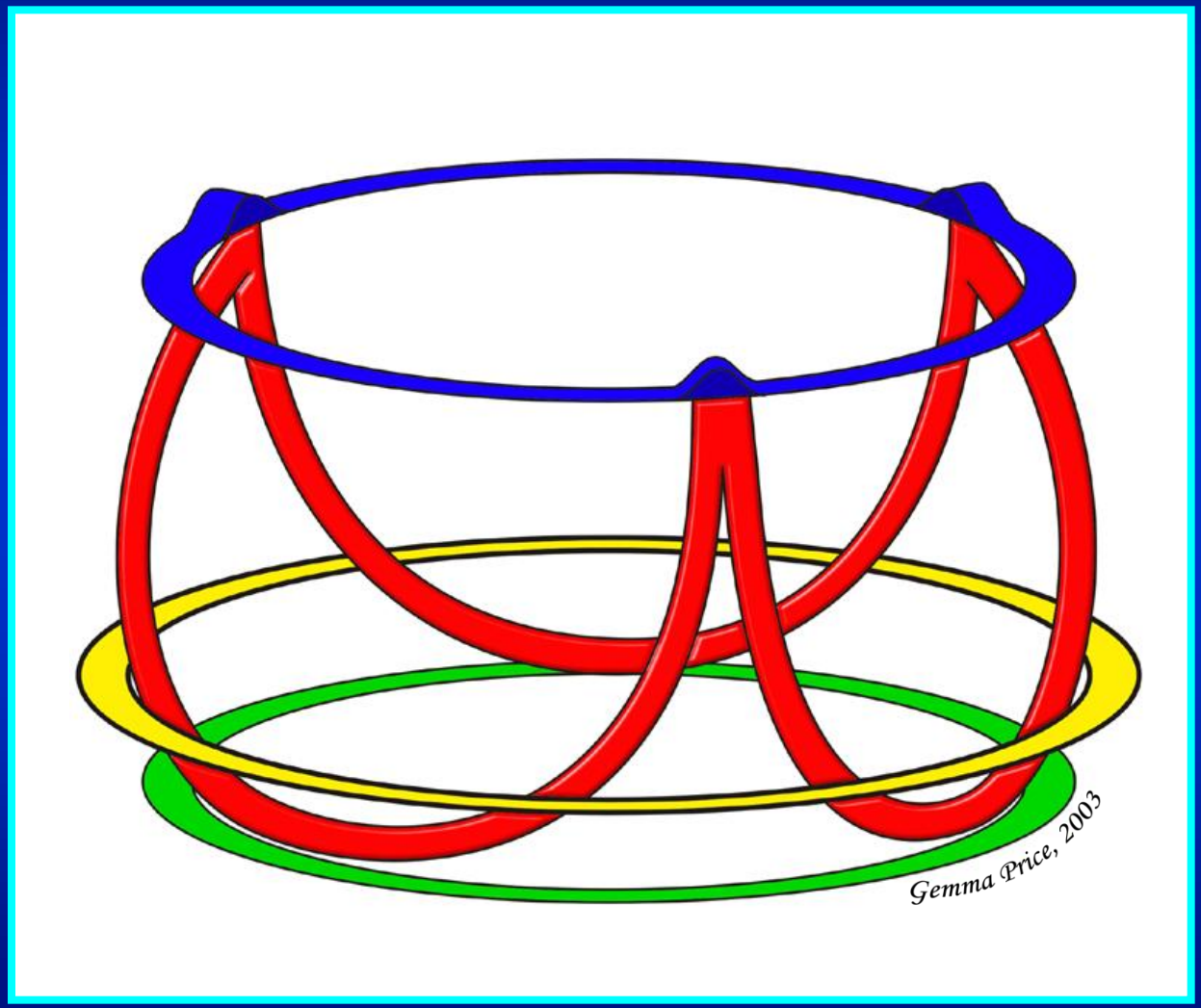
Fattouch
2011



Rankin
2011

Need for standardization

What is the aortic annulus from a surgical point of view ?



STJ

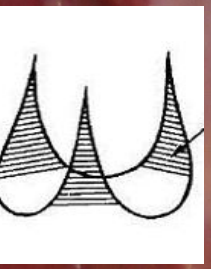
Ventriculo-aortic junction

Virtual ring

From Anderson R. with permission

Sino-tubular junction

Aortic annular base

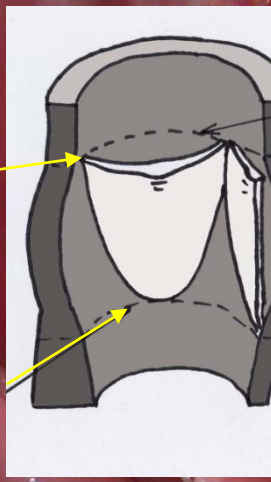


3D

2D

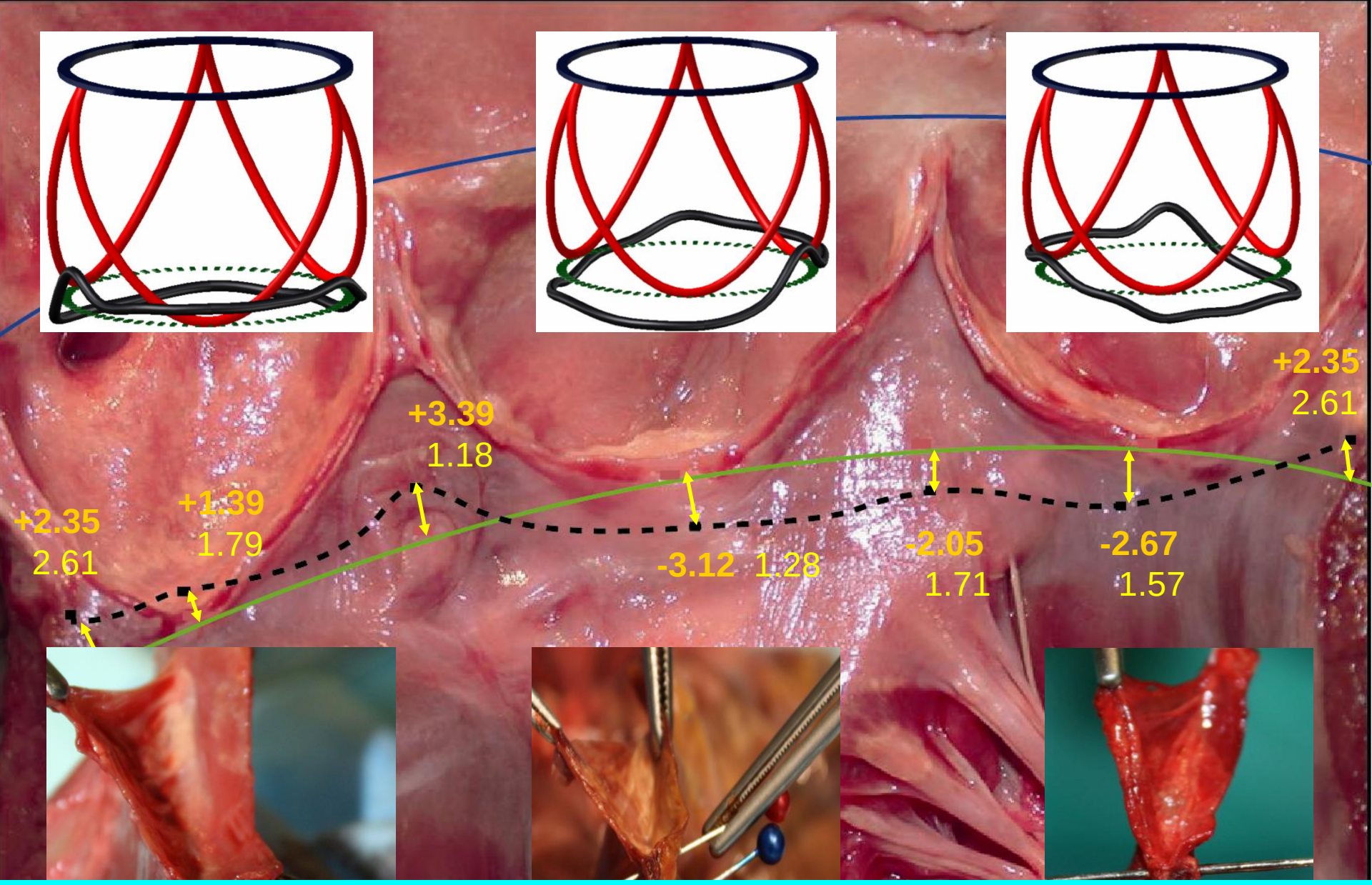
+

2D

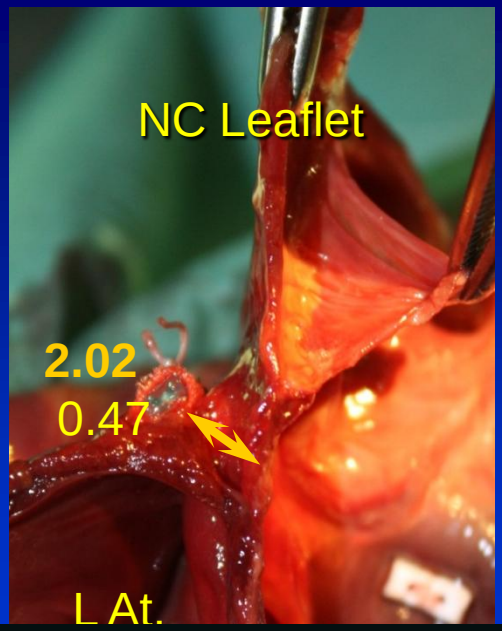


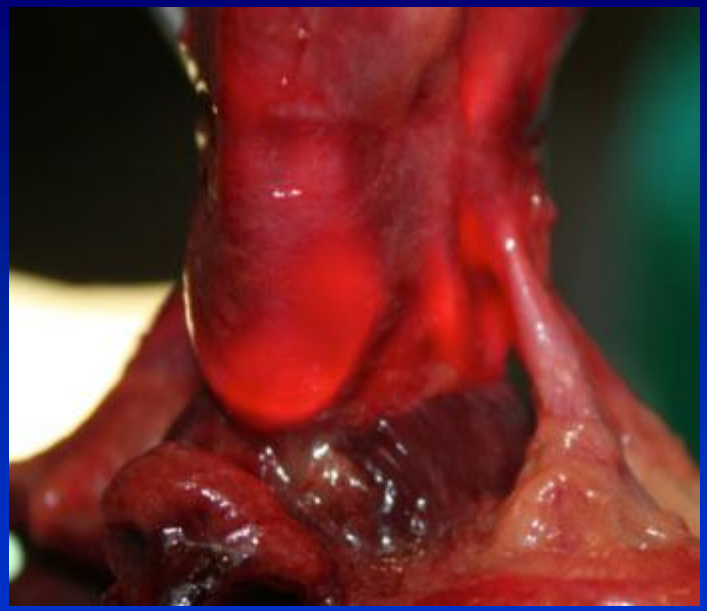
Sutton et al. ATS 1995

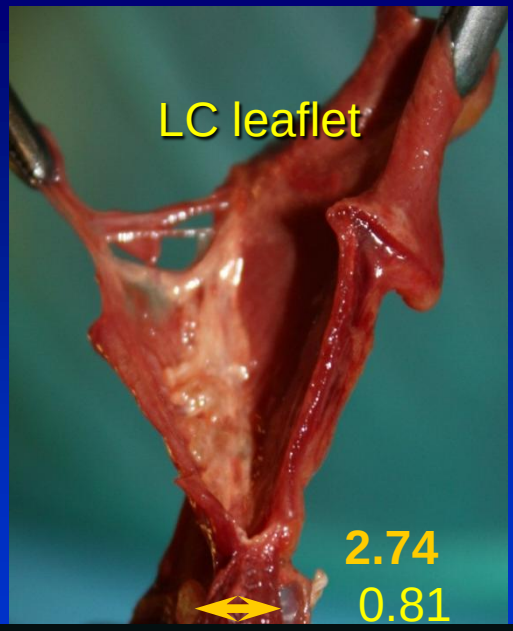
Anderson et al. ATS 1991



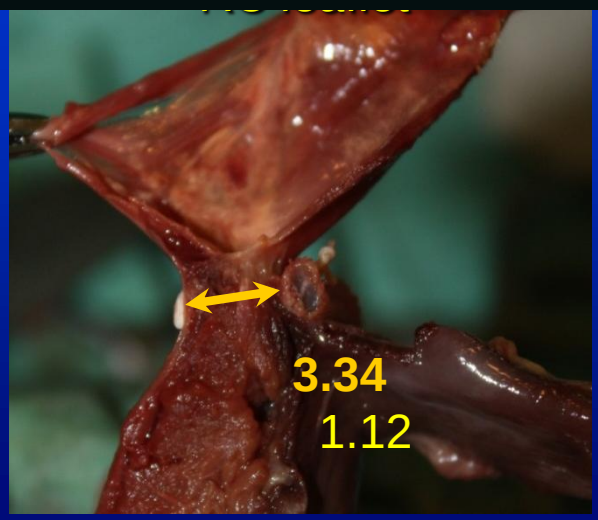
Aortic annuloplasty can be performed in the subvalvular plan, except at the level of the infundibulum where the dissection stops 1,4 1,8 mm above the nadir of the right coronary sinus

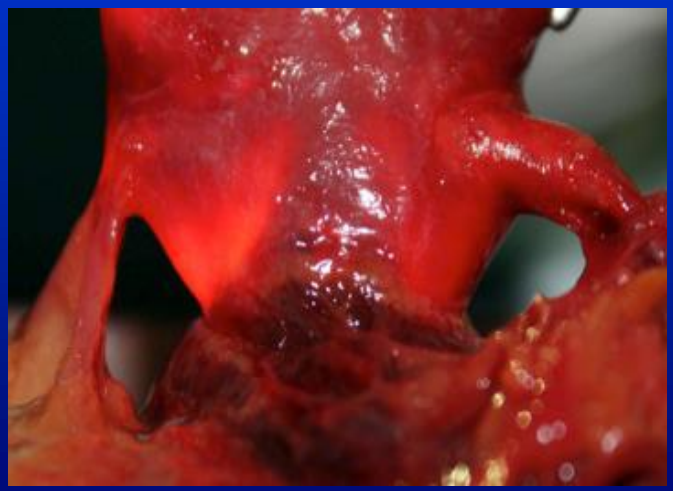






External aortic annuloplasty induces a minimum of 5 mm reduction of aortic annular base diameter, corresponding to tissue thickness

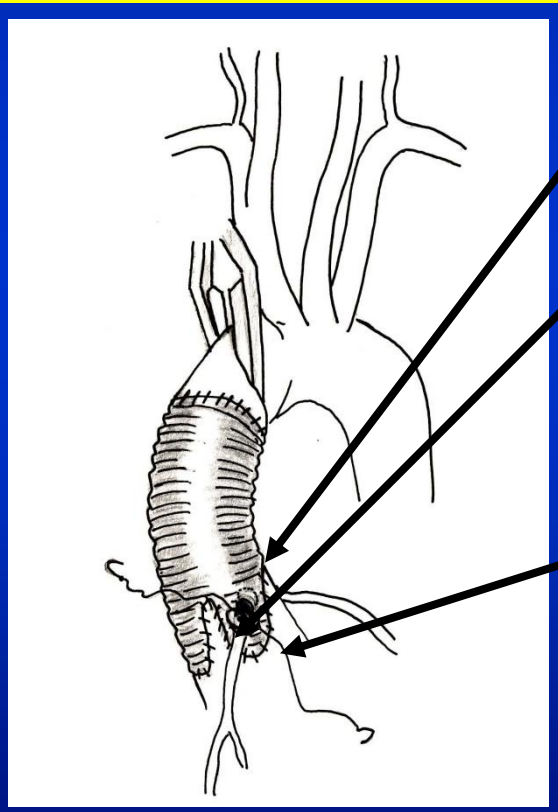




Aortic root aneurysm

Remodeling of the aortic root
Yacoub 1983

Reimplantation of the aortic valve
David 1992

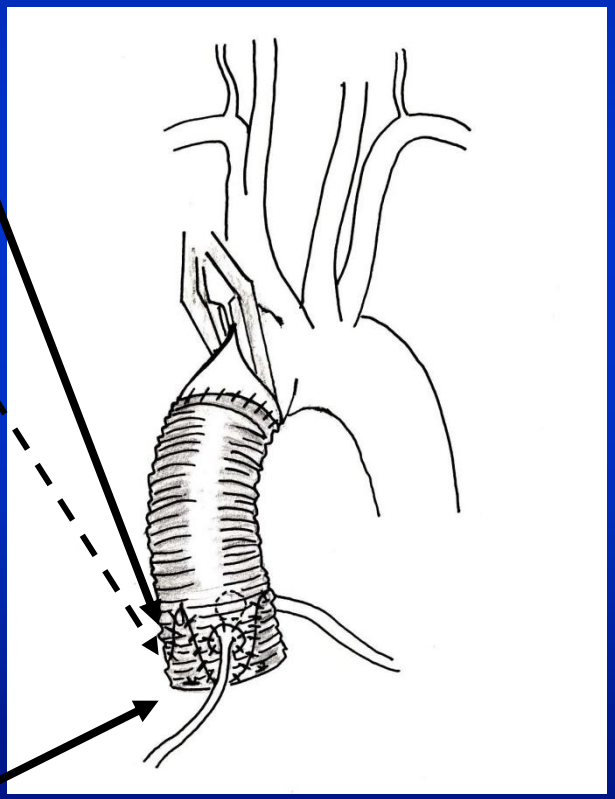


\+ Treatment of STJ dilation

\+ Sinuses of Valsalva

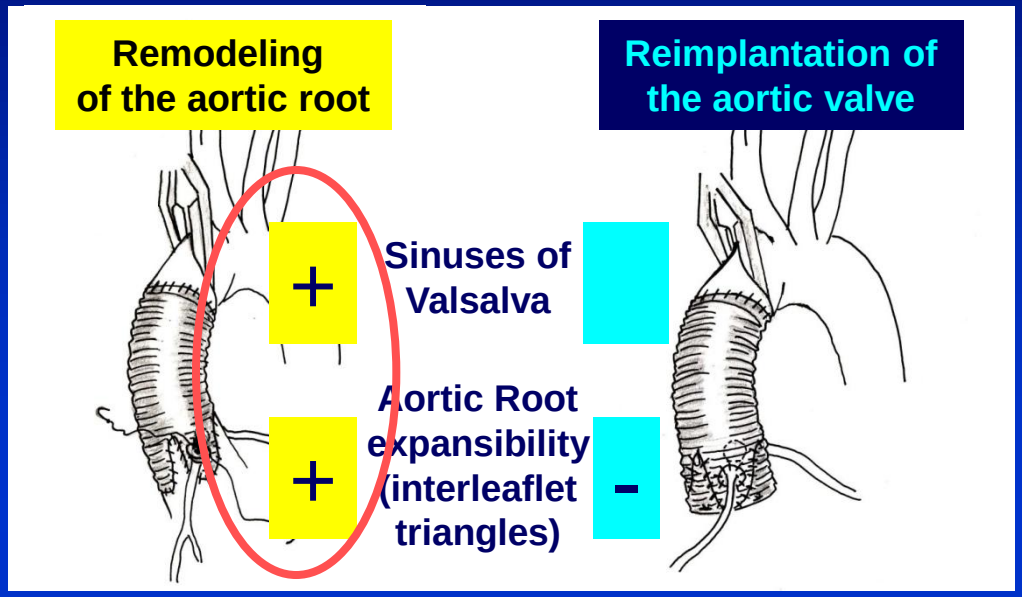
\+ Aortic Root expansibility (interleaflet triangles)

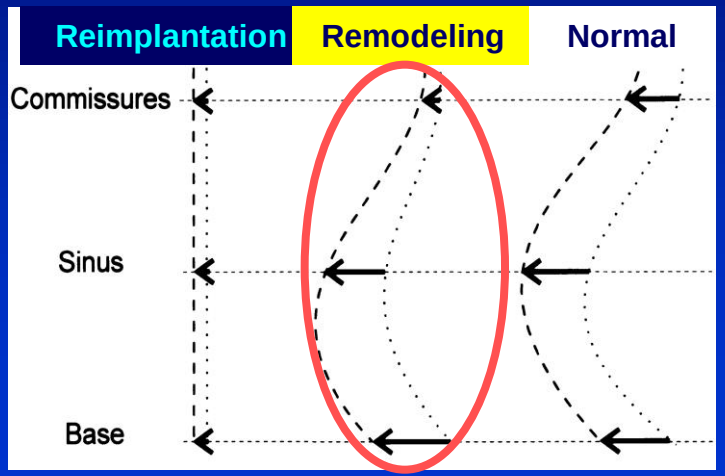
\- Treatment of aortic annular base dilation



\+ external aortic annuloplasty

Aortic root dynamics after valve sparing





Leyh RG. Circulation 1999

Cusp motion and expansibility of the aortic root are best preserved

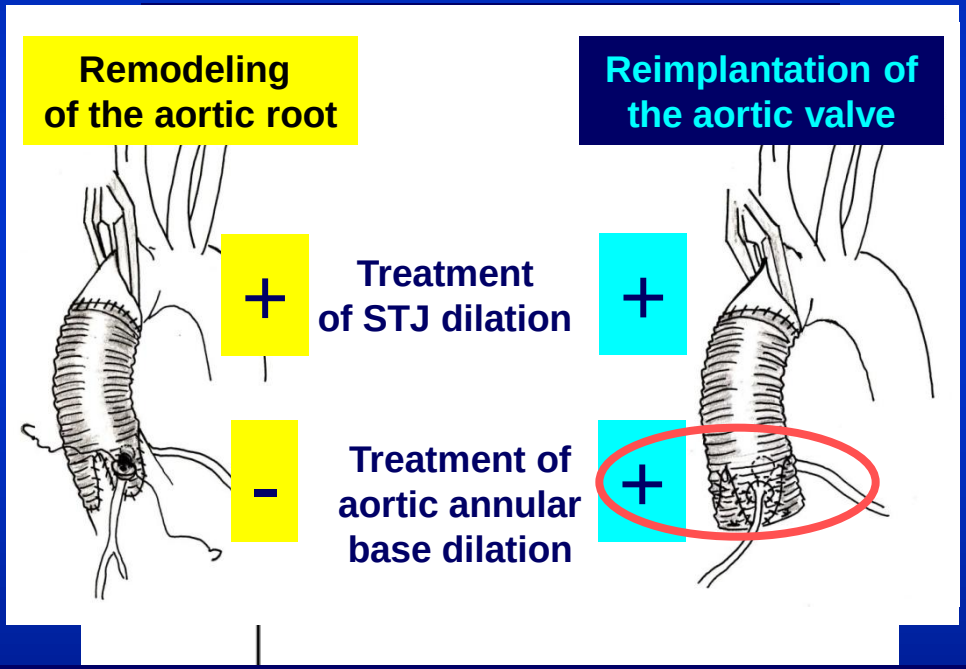
1) after Remodeling than after Reimplantation

2) with graft with neo- sinuses of Valsalva than without

Remodeling provides the most physiological root reconstruction

Aortic annuloplasty and valve sparing root replacement ?

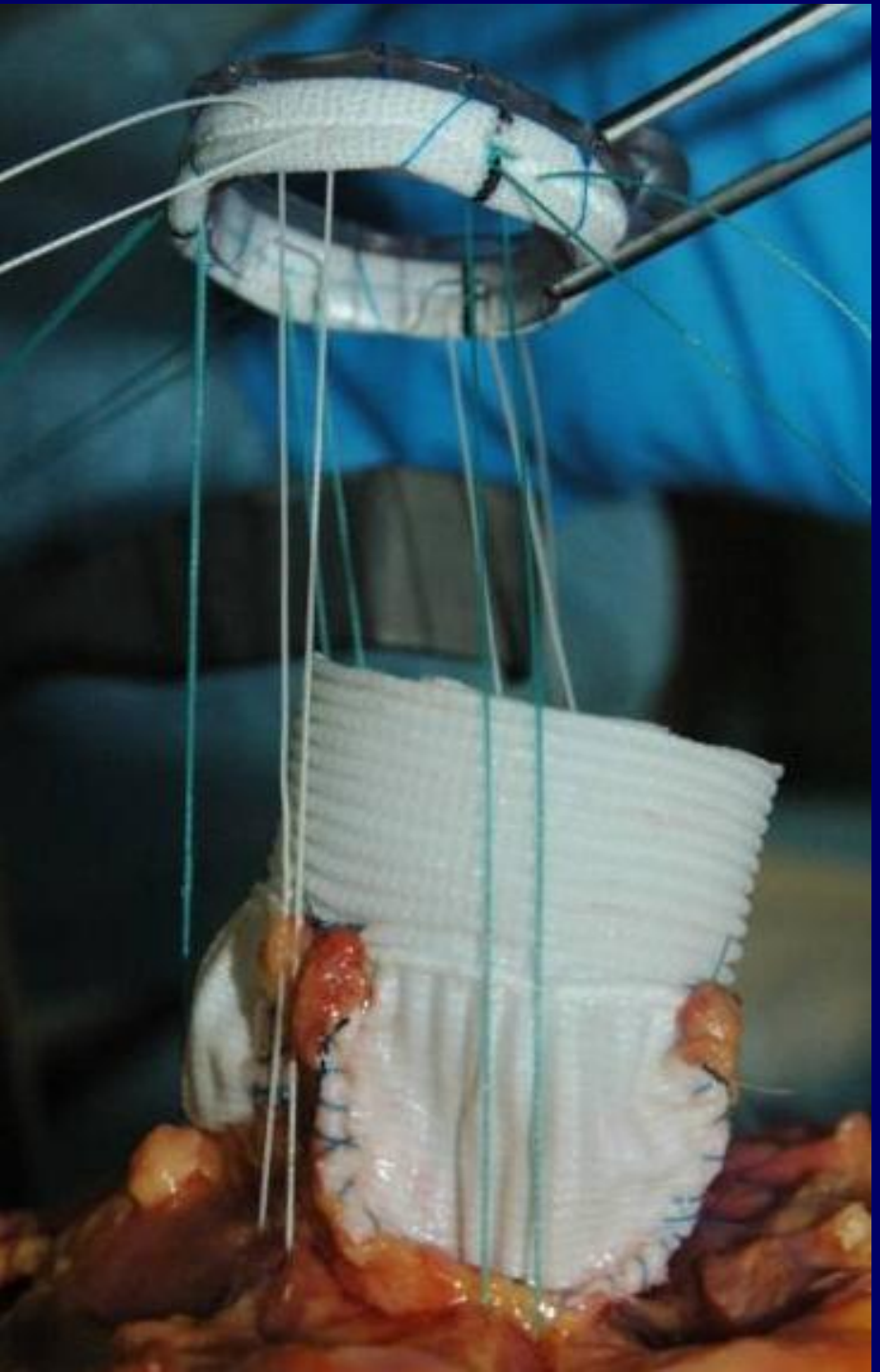
Risk factor for failure of the Remodeling :
Annulus dilation >25-28 mm

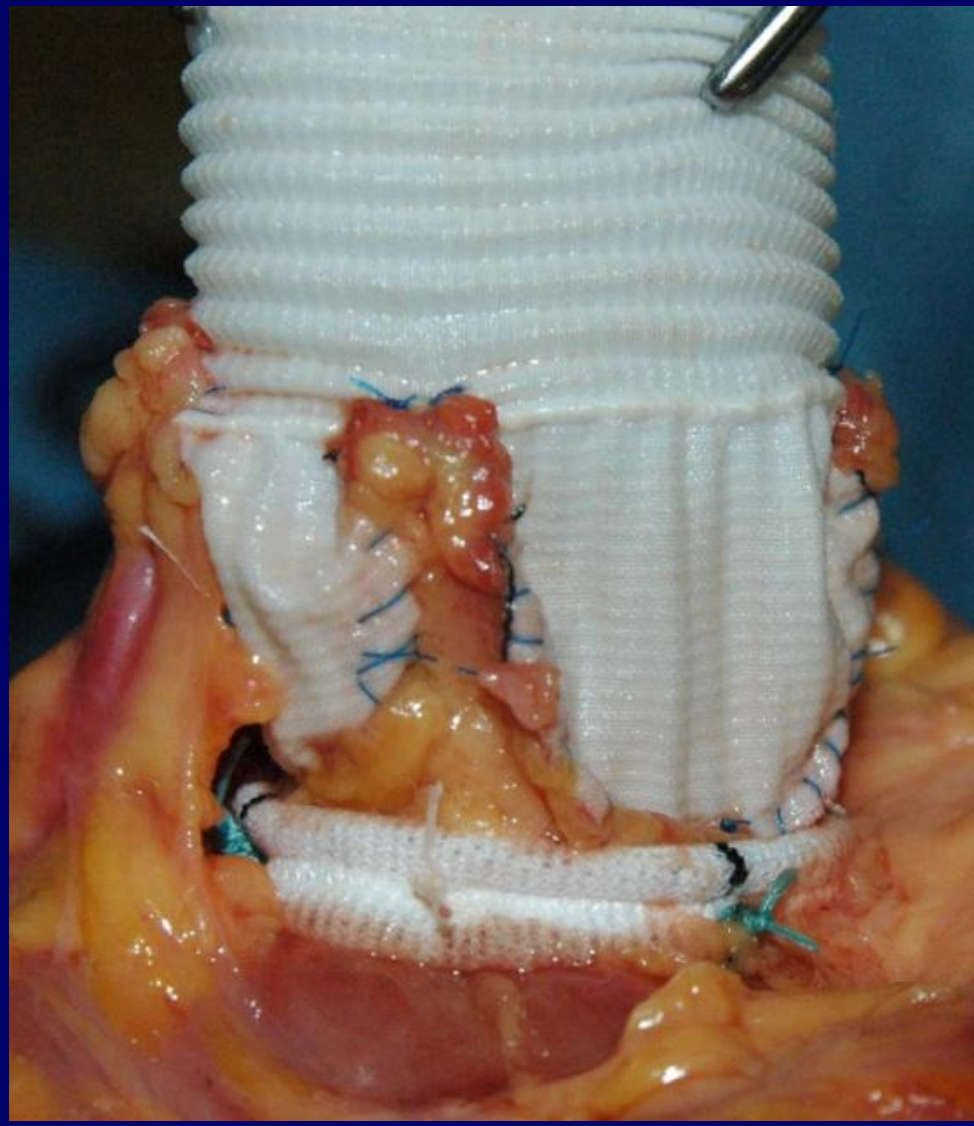


Reimplantation performs a subvalvular annuloplasty

Remodeling alone is a contraindication if annulus>25 mm

Burkhart JHVD 2003 Lansac EJTCVS 2006 Hanke JTCVS 2009 David JTCVS 2010 Kunihara JTCVS 2011



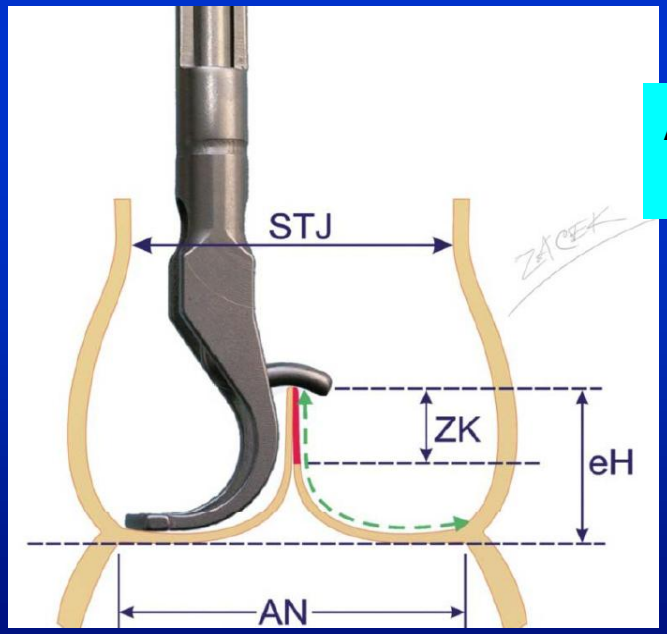


Reasons for valve sparing failures

Cusp prolapse

Remodeling / Reimplantation → **Reduction of the STJ** → **Symmetrical prolaspse**

↓ eH : - 3 to - 4 mm



Absence of eH resupension (Eye balling repair)

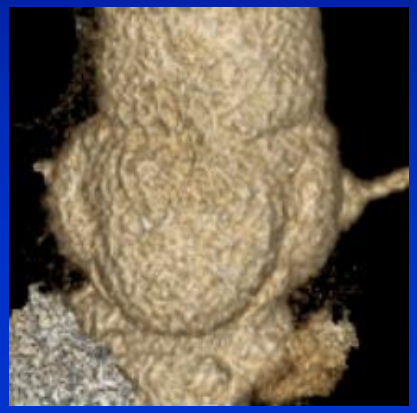
Risk factor for AI recurrence Reoperation

Lansac JTCVS 2010

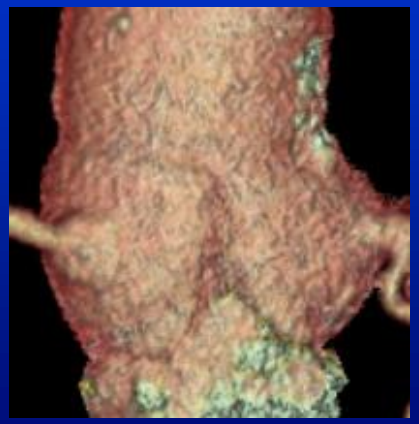
Soncini. MEP 2009 Bierbach E JTCVS 2010 Jeanmart ATS 2007 De Paulis 2010

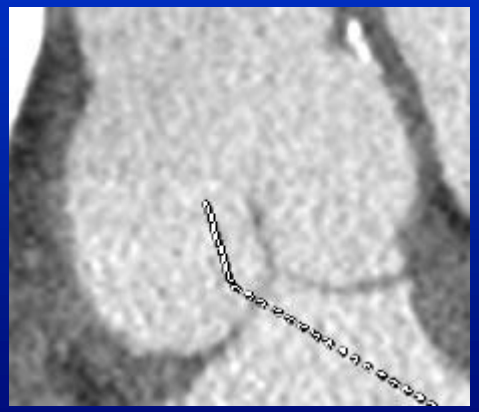
Oka ATS 2011 Kunihara JTCVS 2011 **Cusp eH resuspension** Marom JTCVS 2012 Zacek with permission

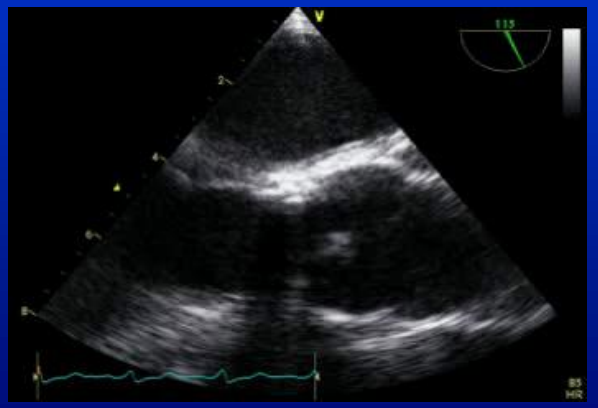
Physiological and standardized aortic valve repair



Physiological root reconstruction + **Resuspension of cusp effective height** + **Subvalvular aortic annuloplasty**







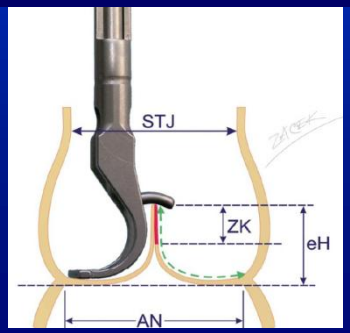
valve repair and annuloplasty

Mitral valve repair

1) Leaflet repair → **2) Annuloplasty**

Aortic valve repair

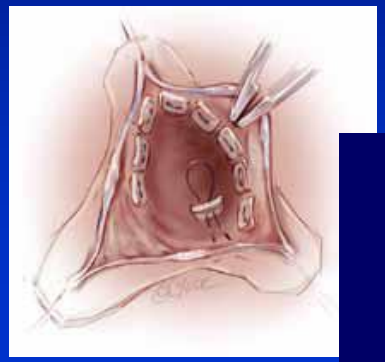
1) Resuspension of cusp effective height → **2) Annuloplasty**

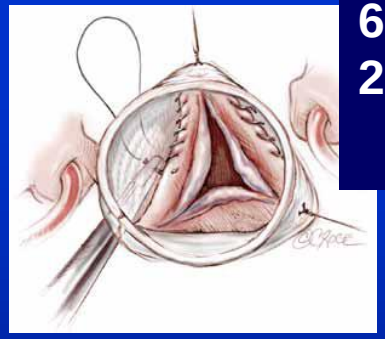


Moving from Valve Sparing to Valve repair

Reimplantation

Remodeling + Ring





Selected cases
(AI ≤ Grade II)

6% of high risk patients
20 % of low risk patients

STS Database, EACTS 2013

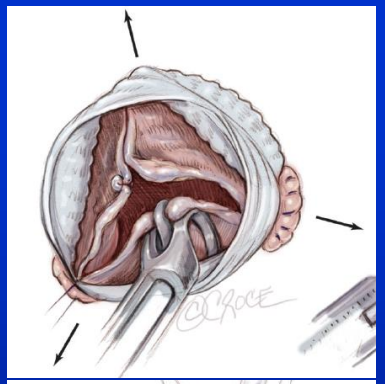
Eye Balling
valve repair

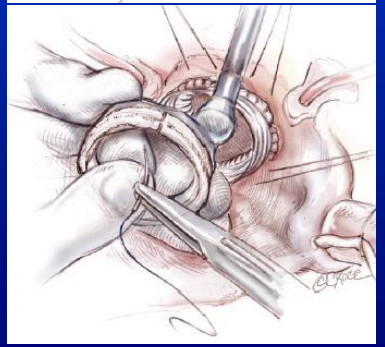
3) Leaflets

1) Root

2) Leaflets
(eH caliper)

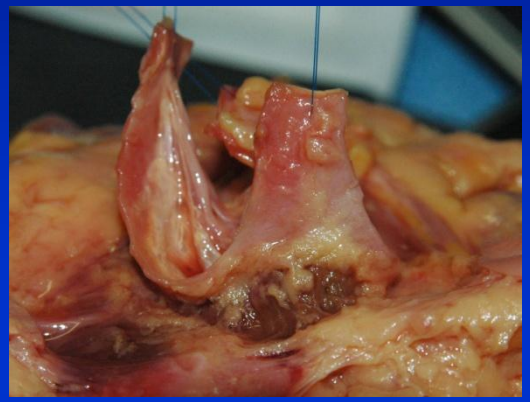
3) Annuloplasty

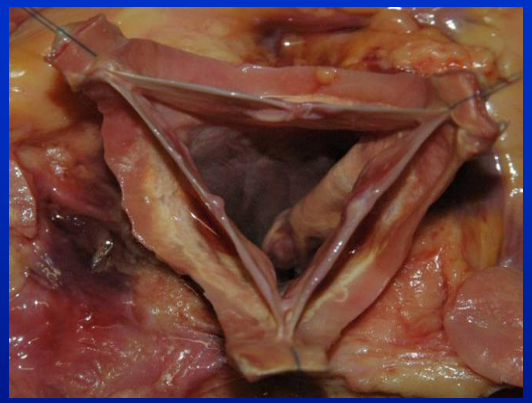




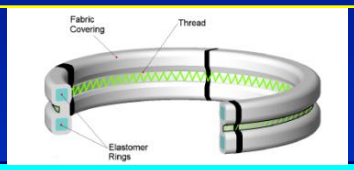
ACS 2013

1.Dissection of the subvalvular plane



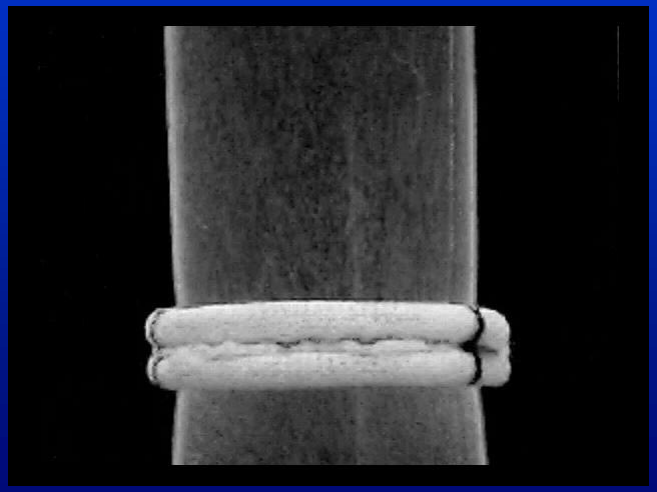


Standardization based on aortic annulus Ø



	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

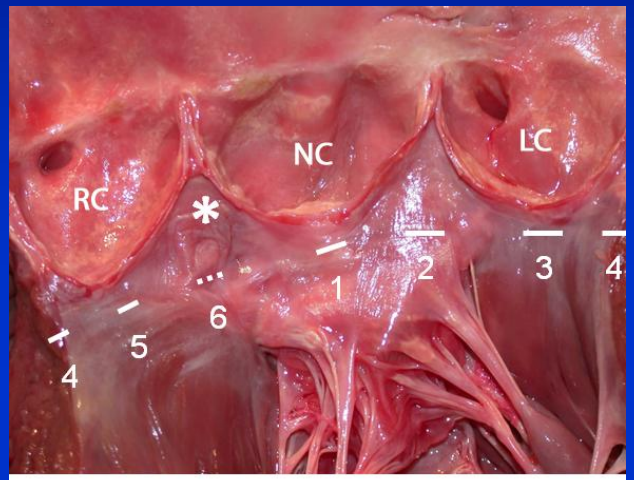


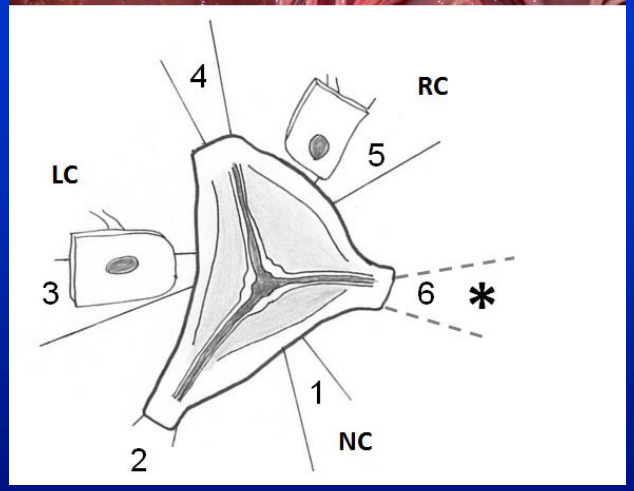
2. Inspection of cusp lesions
Geometric height

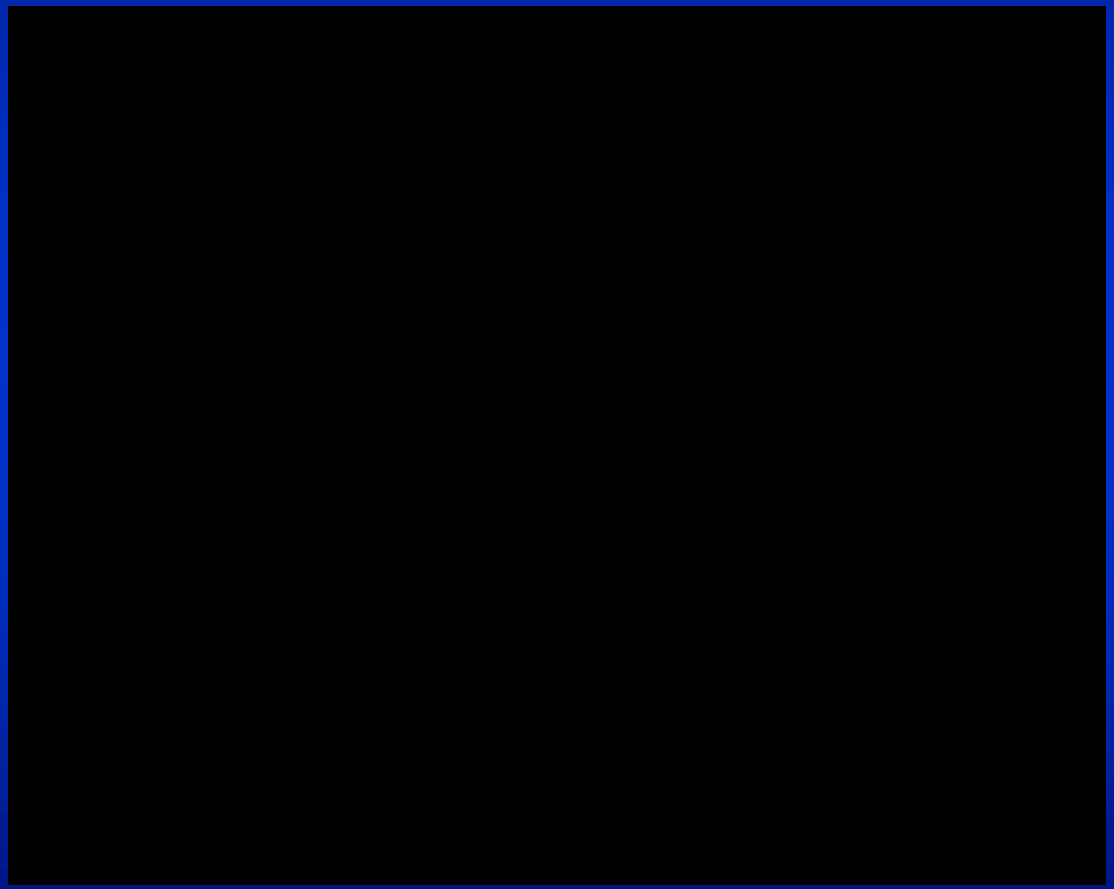
Retracted if <16 mm in tricuspid and <19 mm in bicupid

Schäfers et al., JTCVS 2013

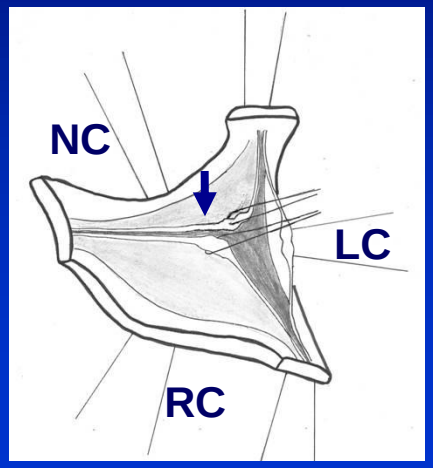
3. 6 subvalvular « U » stitches

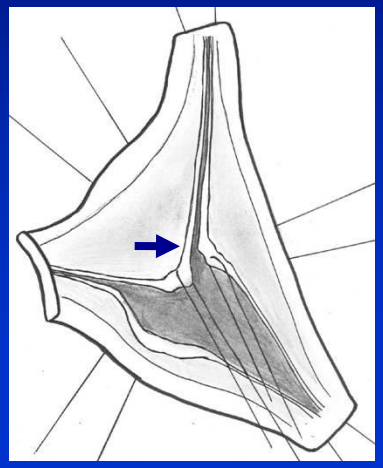


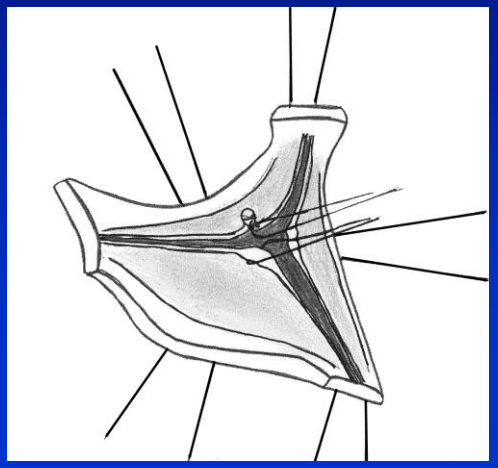


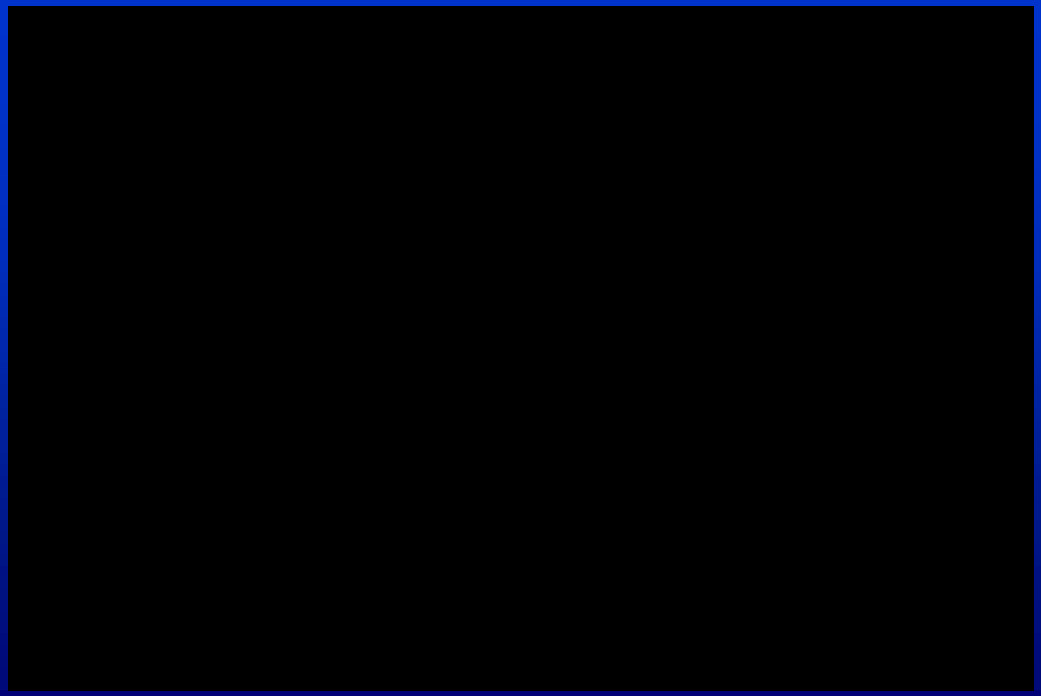


4. Aligment of cusp free edges <u>prior</u> Remodeling



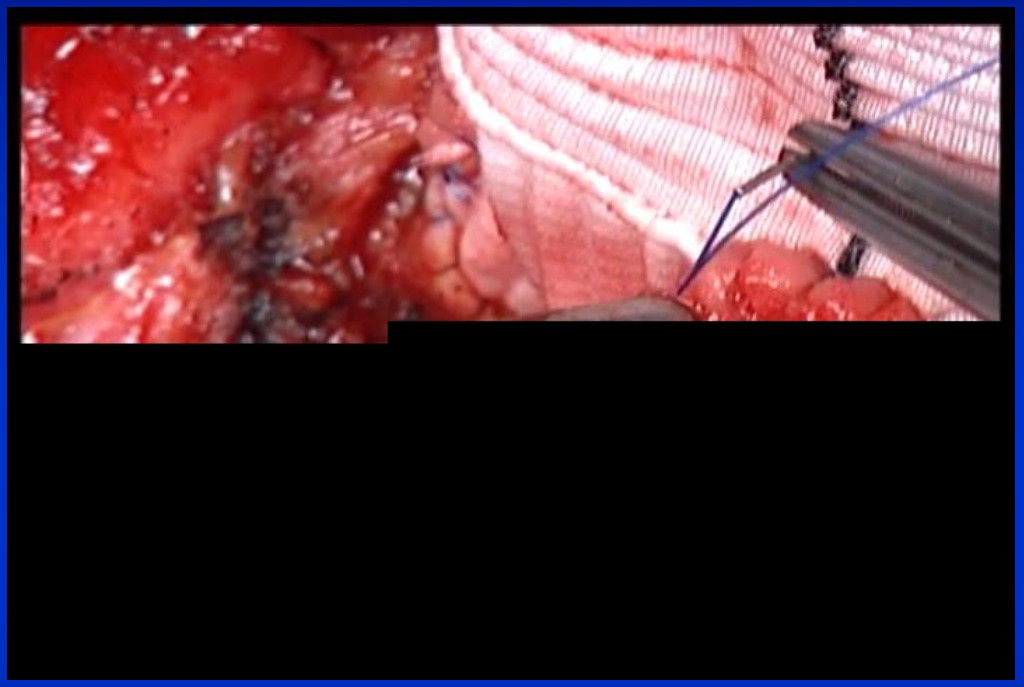


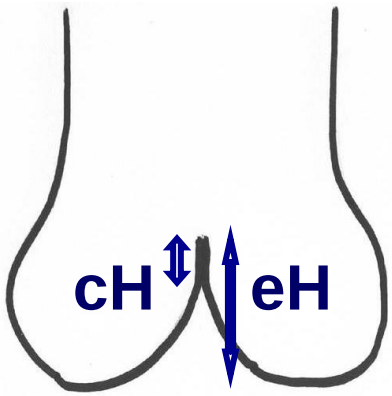


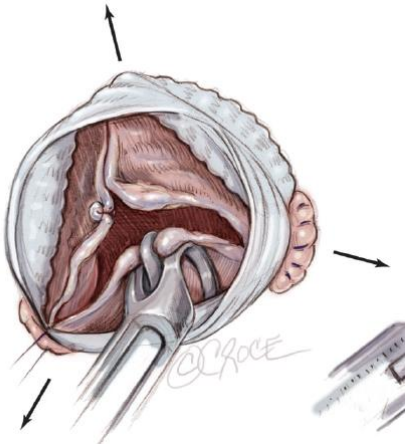


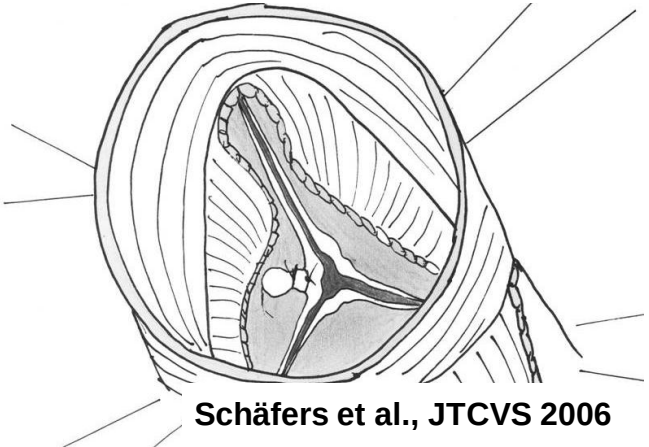
5. Suture of the Remodeling

6. Cusp resuspension <u>after</u> the Remodeling (effective height 9 mm)



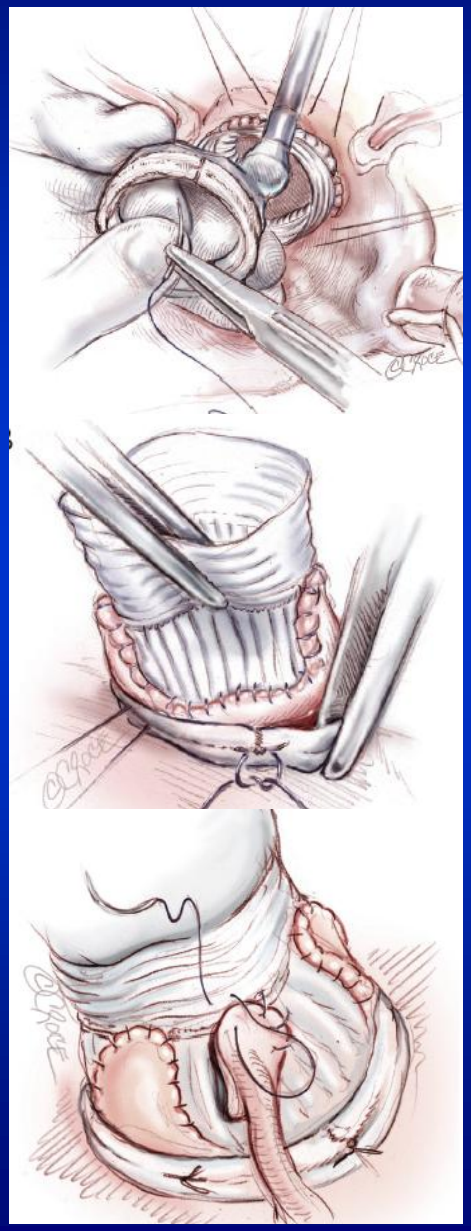






Schäfers et al., JTCVS 2006

7. Subvalvular ring implantation



700 Aortic valve repair using an external aortic ring

Operative mortality 2%

Pr
1

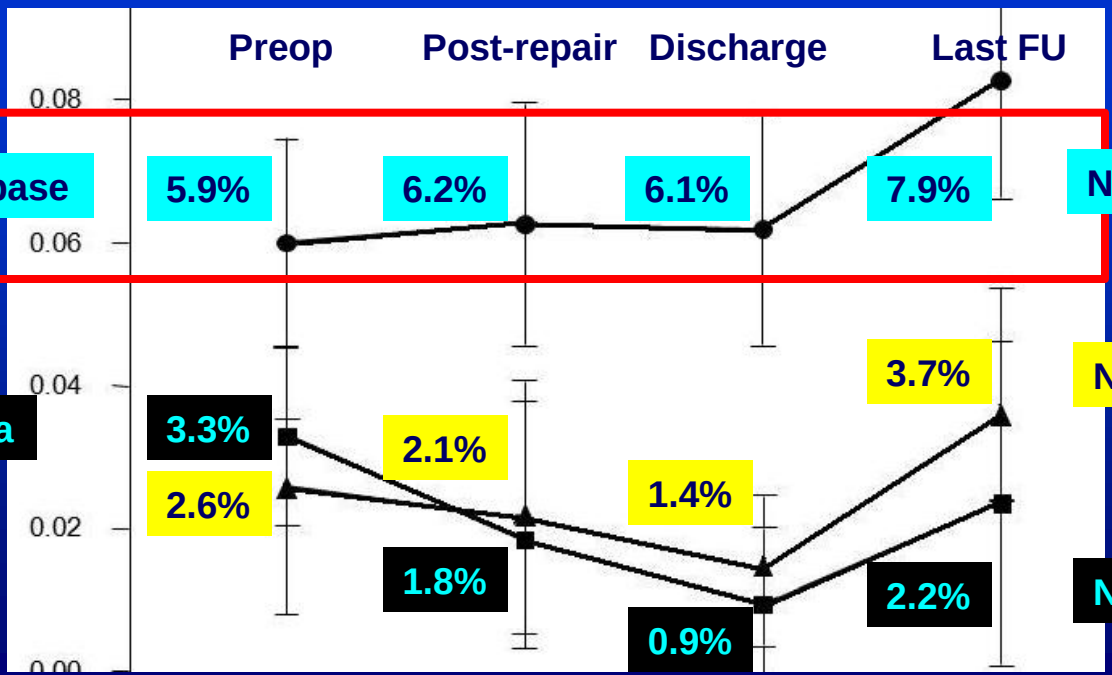
Expansibility is preserved
at the aortic annular base and SoV levels
up to 22 3.7 months (1-64)

CAVIAA Trial

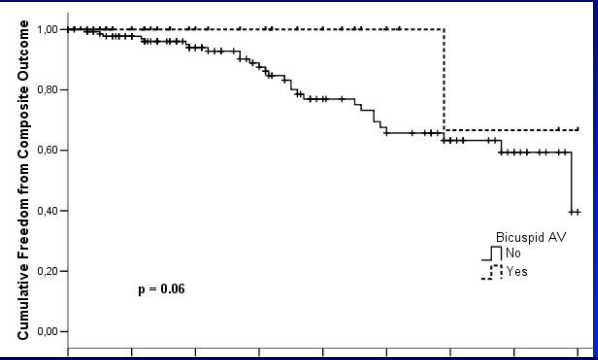
Independent of age and bicuspid valve

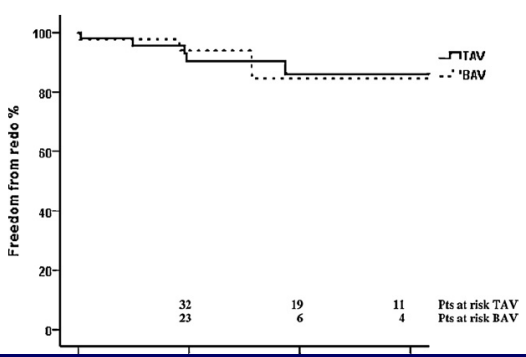
us 130 Bentall

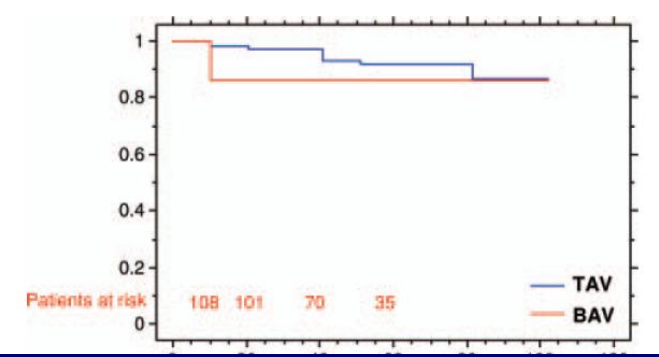
In process for analysis and 10 years follow-up



Should we repair bicuspid valves?



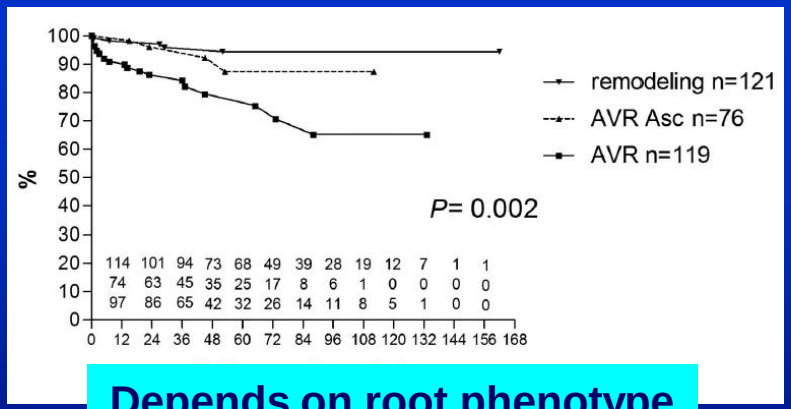




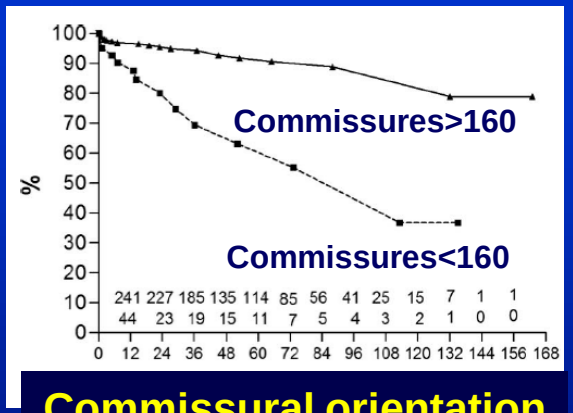
Results of artic valve repair are equivalent for bicuspid and tricuspid valves

Survival 99% at 5 years and 92% at 10 years

Freedom from reoperation 95 % at 10 years for aortic root aneurysm



Depends on root phenotype



Commissural orientation

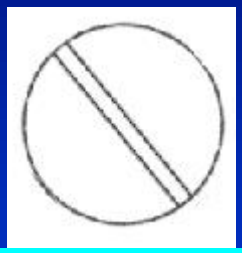
Risk factors for reoperation: Ø annulus>28mm, eH<9 mm, Sub commissural annuloplasty

Aicher Circulation 2011; Navarra EJTCVS 2013

Aortic valve
Tricuspid

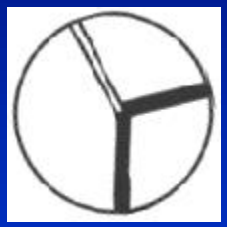
Bicuspid valve

Type 0
0 raphe



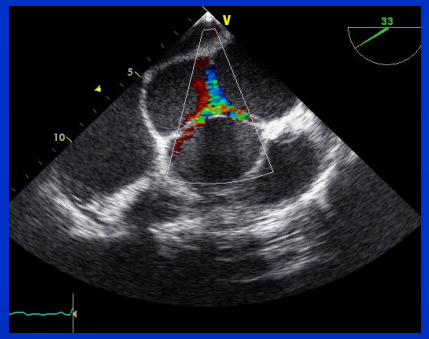
Type 1
1 raphe

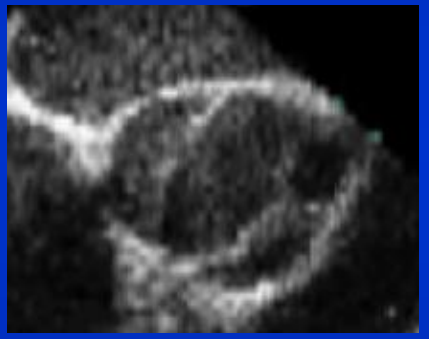
Type 2
2 raphes

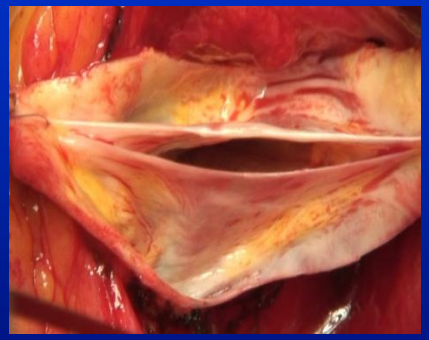


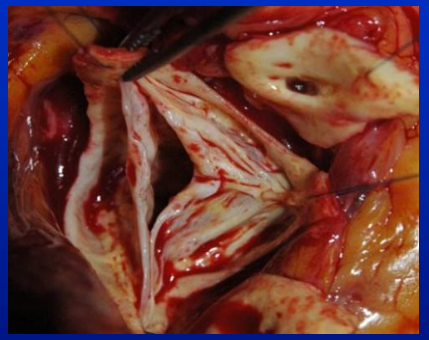
Valves amenable to repair

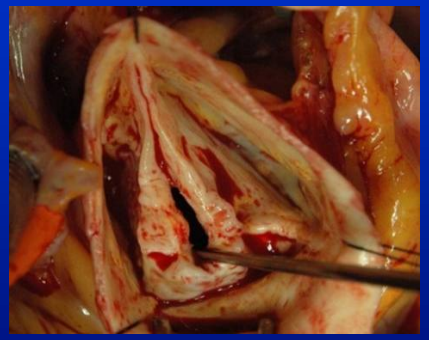
Unicuspid

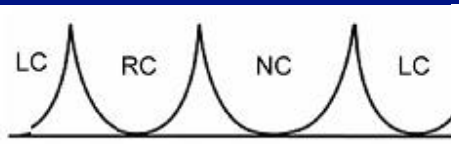


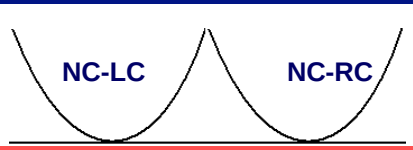


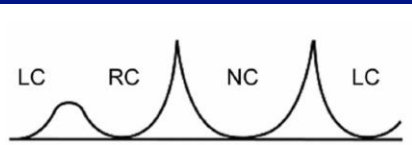


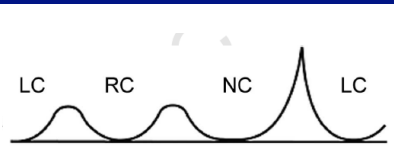






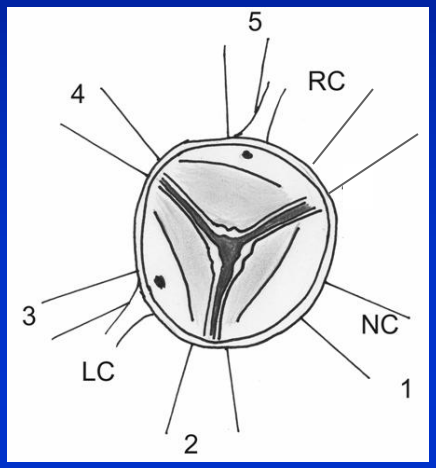




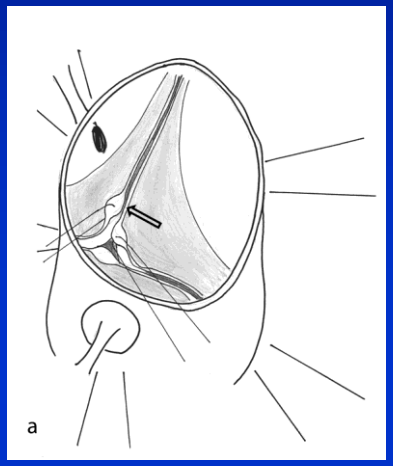


Repair for isolated aortic insufficiency

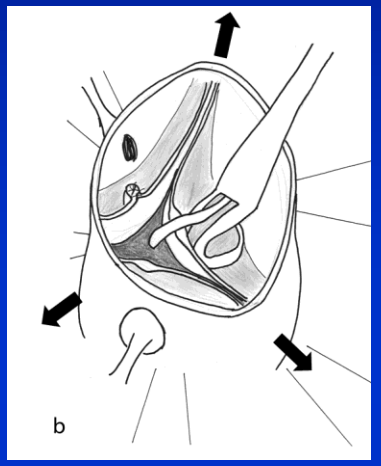
6 subvalvular « U » stitches



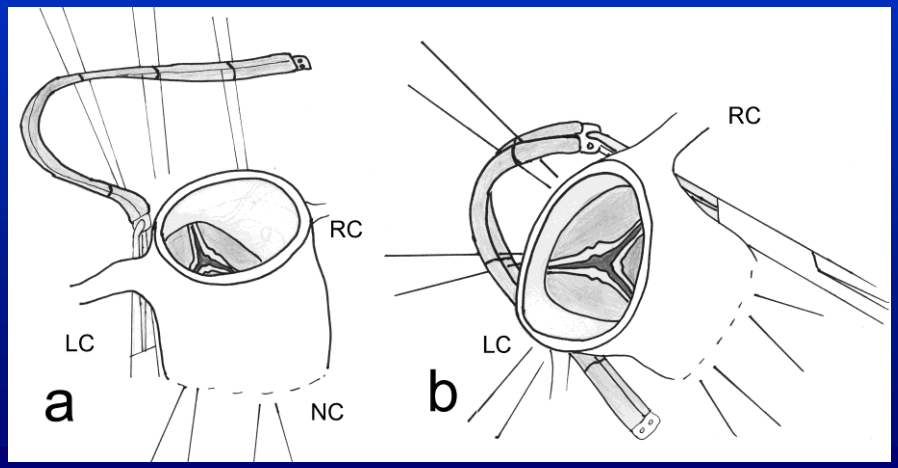
Aligment of cusp free edges



Cusp resuspension (effective height ≥9 mm)

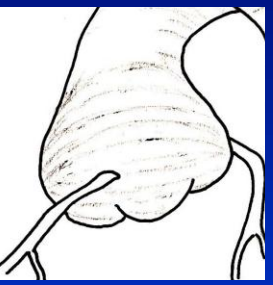


Placement of the open subvalvular ring below the coronaries



Final aspect

Dystrophy of the ascending aorta pliable bicuspid and tricuspid valves

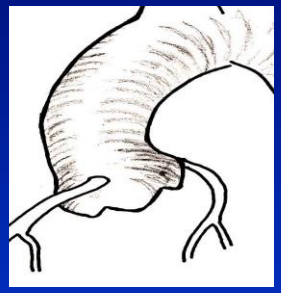


Aortic root aneurysm

Valsalva ≥45 mm

Supra-coronary aneurysm

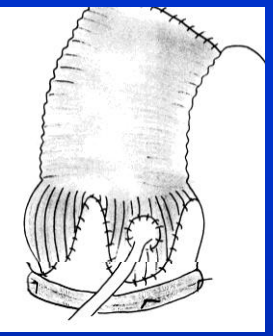
Valsalva<40 mm



Isolated AI

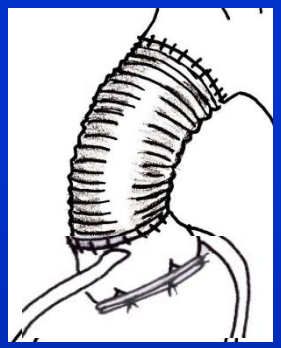
all Ø < 40 mm

Standardized approach according to phenotypes



Remodeling

+ subvalvular annuloplasty



Supra-coronary graft

+ subvalvular annuloplasty

(annulus > 25 mm)

Subvalvular annuloplasty

(annulus> 25 mm)

Cusp repair

Alignment of the cusp free edges

Resuspension of cusp effective height

+

Subvalvular external aortic annuloplasty

AVIATOR

International Multicenter Registry

AI ≥ 2 and/or ascending aorta aneurysm

Isolated AI

Root aneurysms

Supracoronary aneurysm

Medical Registry

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