

# Sutureless/Rapid-deployment AVR, TAVR and Aortic Valve Repair

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Severance

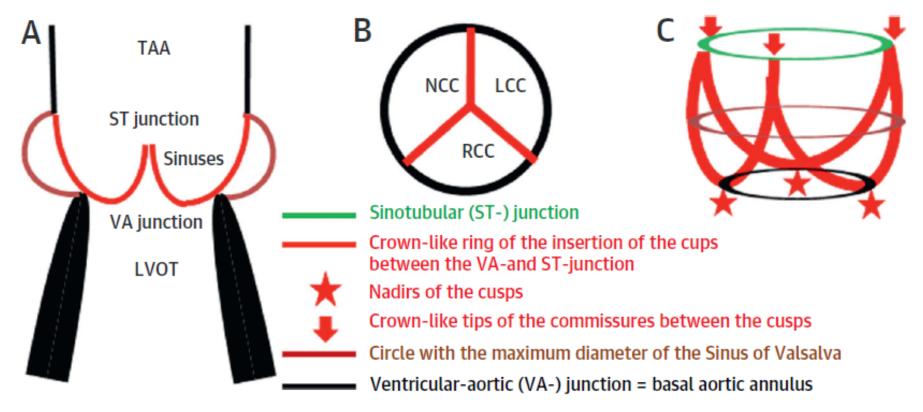


# **Aortic Valve Repair**

: Valve Sparing Root Replacement



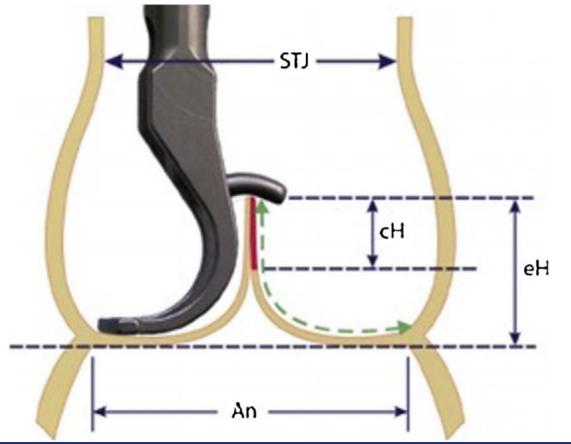
### Anatomy of aortic valve

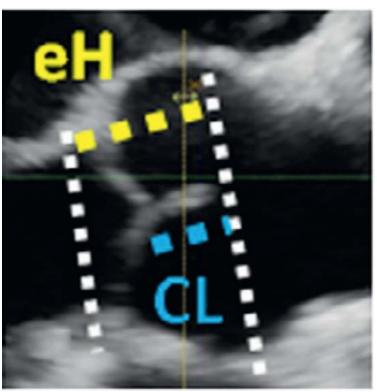


Andreas Hagendorffet al., J Am Coll Cardiol Img 2019;12:2225 –44.



## Anatomy of aortic valve

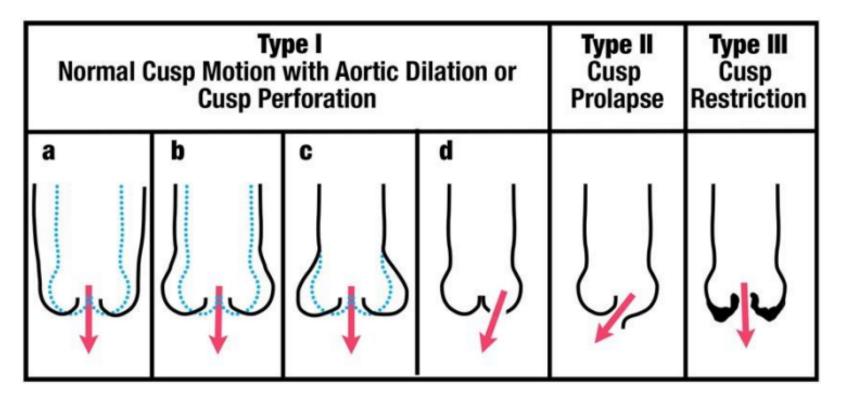




Rimmer L. et al., Heart Lung Circ. 2019;28:988-999.

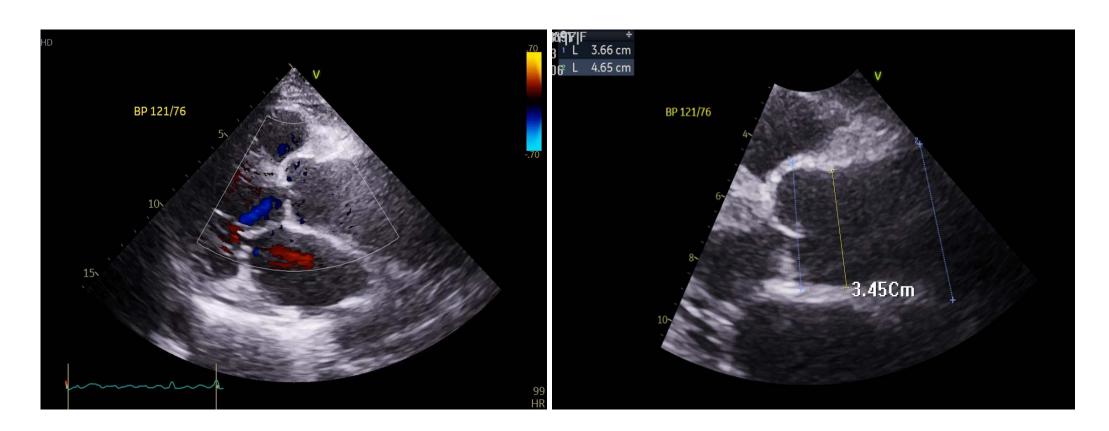


### **Aortic regurgitation**





## Type 1A AR



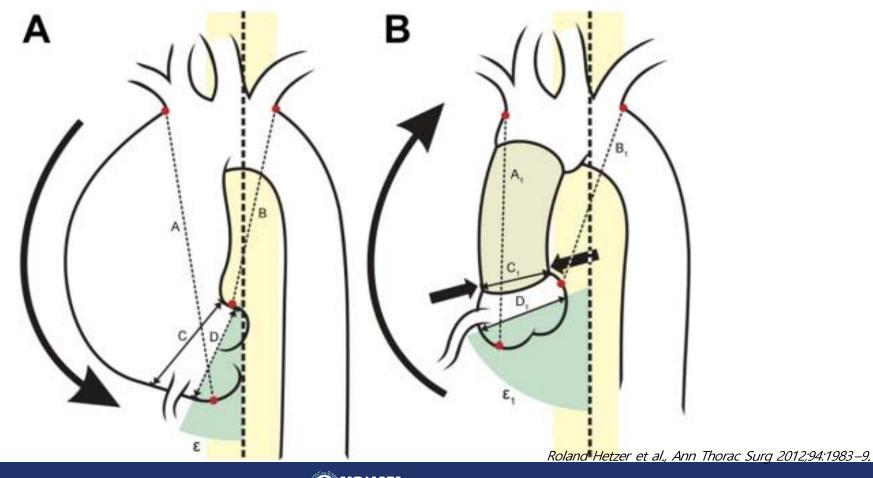


## Type 1A AR

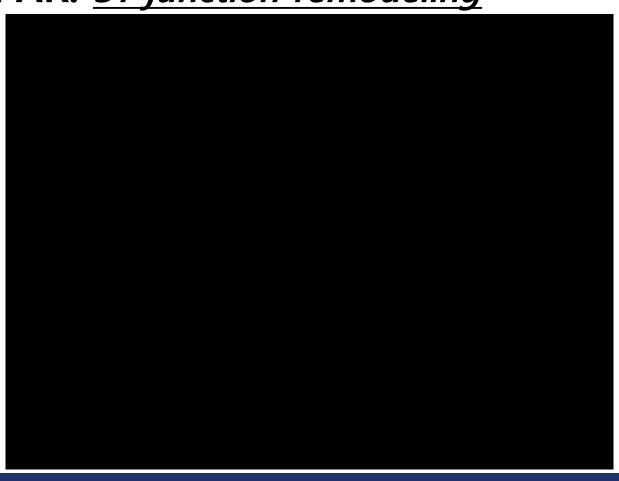




## Type 1A AR: <u>ST junction remodeling</u>

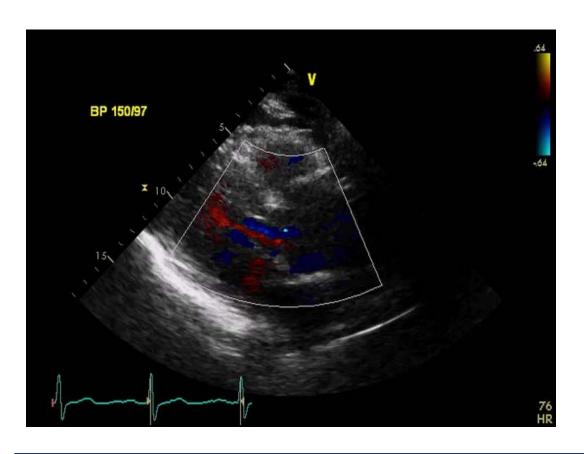


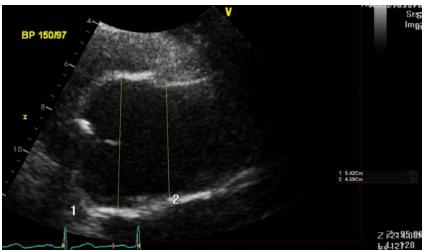
Type 1A AR: <u>ST junction remodeling</u>





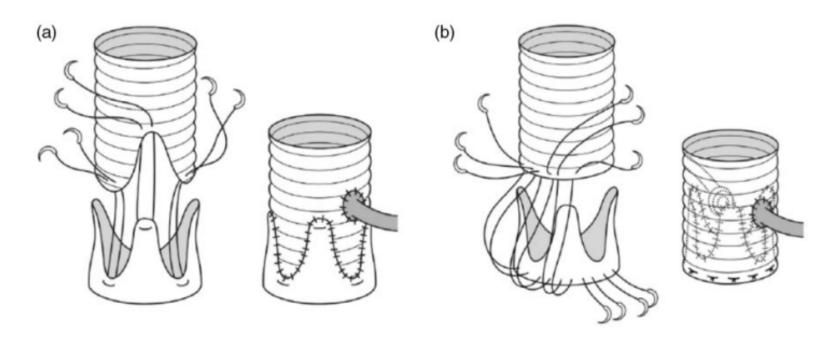
## Type 1B AR









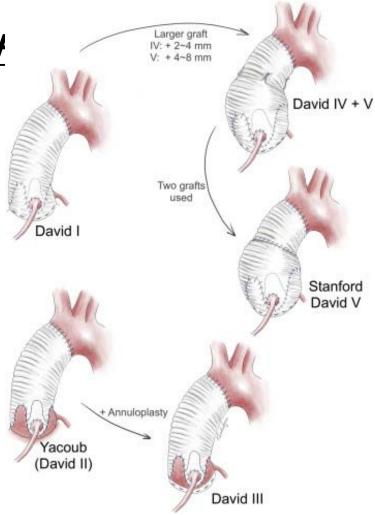


Aortic root remodeling

Aortic valve reimplantation

Shimizu H et al. Ann Thorac Cardiovasc Surg 2011;17:330-336.





Zara Khachatryan et al. J Thorac Cardiovasc Surg. 2021 Apr 3:S0022-5223(21)00585-7.



1 - The aortic root prepared



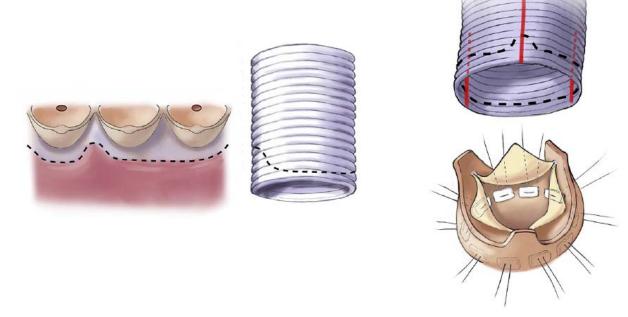
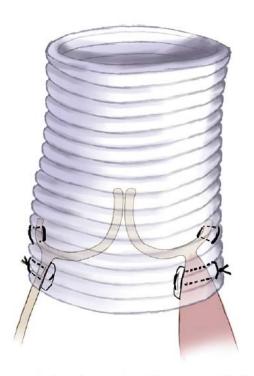
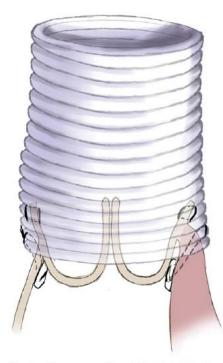


FIGURE 3. The aortic annuloplasty stitches are passed from the inside to the outside of the left ventricular outflow tract through a single horizontal plane except for the area of right coronary cusp, where it may have to be placed into its subcommissural triangles (*left panel*). The bundle of His should be avoided and that space left without a suture. These suture line must be spatially placed in the Dacron graft using the same spatial distribution as in the left ventricular outflow tract (*right panel*).







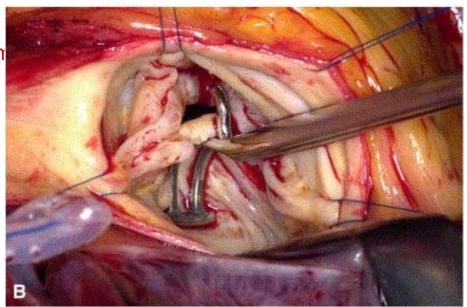
**FIGURE 4.** Once the annuloplasty is completed, the aortoventricular junction must lay inside the Dacron graft, as illustrated in the sketch on the *left panel*. If the graft lies at the same level as the aortic annulus or above it as shown on the *right panel*, early failure is likely to occur. This is largely due to inadequate dissection of the outflow tract and placement of the sutures.



3 - Proximal end trimmed



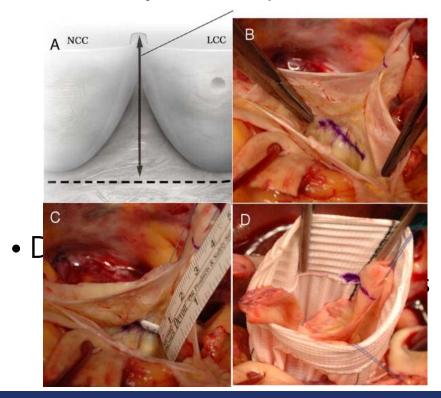
- Feindel-David formula
  - (leaflet height \* 2/3 \* 2) + (2 \* thickness of the aortic wall)
    - Leaflet height=18mm
    - Internal radius=18\*2/3\*2=24mm
    - External diameter=24+4~6mm=28~30mn

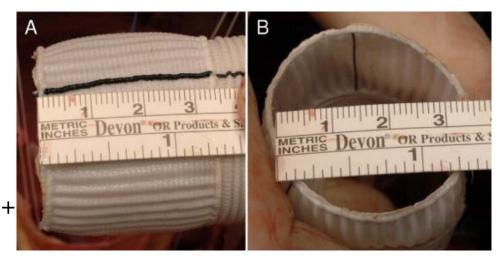






• El Khoury technique



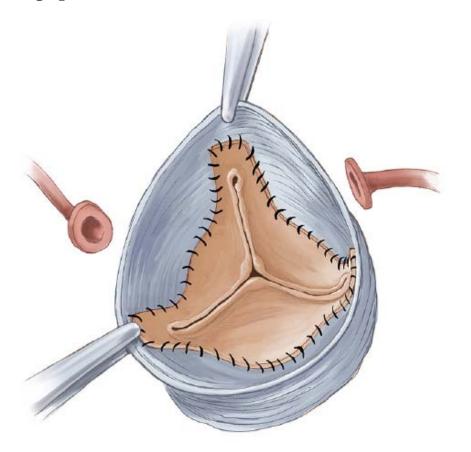


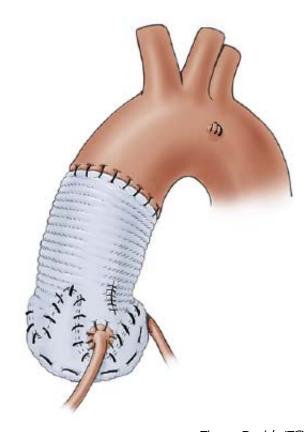




4 - Reimplantation at the level of sinotubular junction

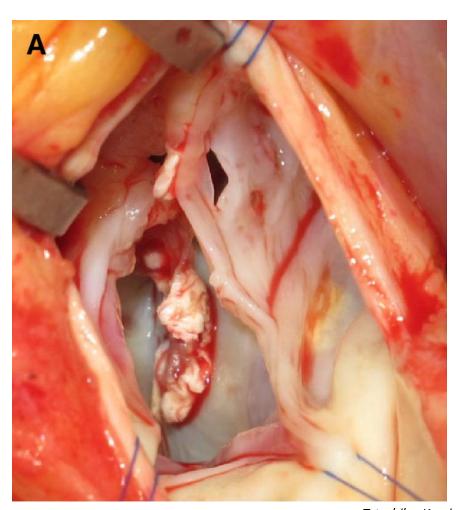








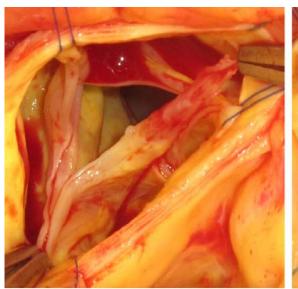
## Type 1D AR



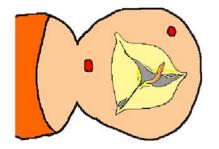
Tatsuhiko Komiya. Gen Thorac Cardiovasc Surg 2015;63:309-319.

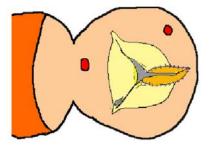


## Type 1D AR: <u>Patch repair</u>





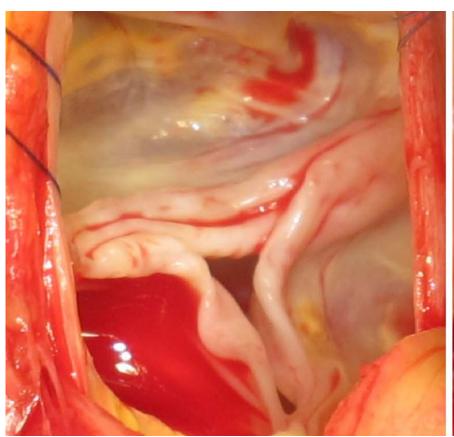


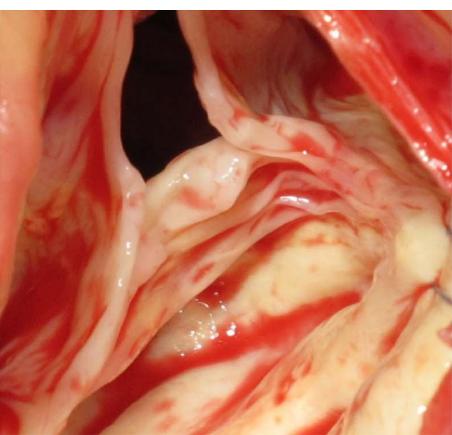


Tatsuhiko Komiya. Gen Thorac Cardiovasc Surg 2015;63:309-319.



## Type 2 AR





Tatsuhiko Komiya. Gen Thorac Cardiovasc Surg 2015;63:309–319.

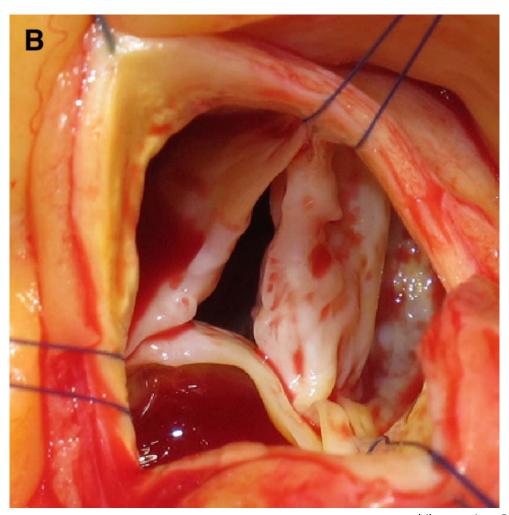


## Type 2 AR: Free margin plication





## Type 3 AR



Tatsuhiko Komiya. Gen Thorac Cardiovasc Surg 2015;63:309-319.



## Aortic valve repair

Al Olasa	Type I  Normal cusp motion with FAA dilatation or cusp perforation				Type II	Type III
Al Class	la	lb	lc	ld	Cusp Prolapse	Cusp Restriction
Mechanism						
Repair Technique ( <i>Primary</i> )	STJ remodeling Ascending aortic graft	Aortic Valve sparing: Reimplantation or remodeling with VAJ annuloplasty	VAJ annuloplasty	Patch Repair  Autologous or bovine pericardium	Prolapse Repair  • Free margin plication • Triangular resection • Free margin resuspension • Patch	Leaflet Repair • Shaving • Decalcification • Patch
(Secondary)	VAJ annuloplasty		STJ annuloplasty	VAJ annuloplasty	VAJ annuloplasty	VAJ annuloplasty

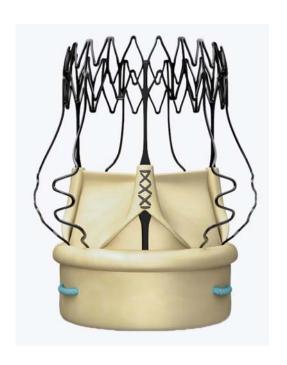
Ming Hao Guo et al., Semin Thoracic Surg 31:650–655.



## Sutureless/Rapid-deployment AVR



# Sutureless , Rapid deployment valve



#### Rapid deployment valve





#### **TABLE 1.** Design Characteristics



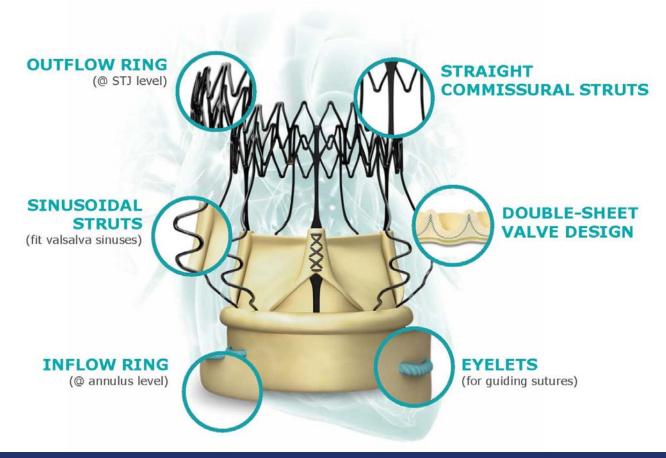


	Edwards INTUITY	Sorin Perceval S		
CE mark	2012	2011		
Available patient follow-up	3 y	5 y		
Design platform	Bovine pericardium, trileaflet, balloon expandable, stainless steel cloth-covered frame	Bovine pericardium, trileaflet, self-expandable nitinol frame with additional proximal and distal rings for annulus fixation		
Available sizes	19, 21, 23, 25, 27 mm	21, 23, 25 mm		
Rinsing	2 times, 60 s each	Not required		
Sutures	3 actual sutures	None/only guiding sutures		
Collapsible	Crimped	Yes, with collapsing tool		

Glenn R. Barnhart et al., Innovations 2016;11:7-14



#### **Basic structure**





#### Indications and contraindications

#### 8. INDICATIONS FOR USE

The Perceval bioprosthesis is indicated for the replacement of diseased, damaged, or malfunctioning native or prosthetic aortic valves.

#### 9. CONTRAINDICATIONS

Use of the Perceval prosthesis is contraindicated in the following cases:

- Aneurysmal dilation or dissection of the ascending aortic wall;
- 2. Known hypersensitivity to nickel or cobalt alloys;
- Anatomical characteristics outside the specification given in Table 1.



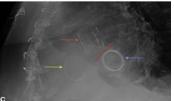
Acquired cardiovascular disease

# Expanding the indication for sutureless aortic valve replacement to patients with mitral disease

Tam Hoang Minh MD, Amine Mazine MD, Ismail Bouhout MD, Ismail El-Hamamsy MD, PhD, Michel Carrier MD, MBA, Denis Bouchard MD, PhD, Philippe Demers MD, MSc ス ☑







Conclusions: In our experience, sutureless AVR in the setting of concomitant mitral surgery is a feasible and reproducible procedure. Elderly patients undergoing multiple valve surgery present a higher operative risk, therefore extending the indication for sutureless AVR to patients with concomitant mitral disease could greatly benefit this specific population. (J Thorac Cardiovasc Surg 2014;148:1354-9)





# Innovations: Technology and Techniques in Cardiothoracic and Vascular Surgery



**TABLE 2.** Recommendations of Experts for the Implantation of Sutureless and Rapid Deployment Valves in Minimally Invasive Aortic Valve Replacement After Second Round of the Panel Process

#### Recommendation

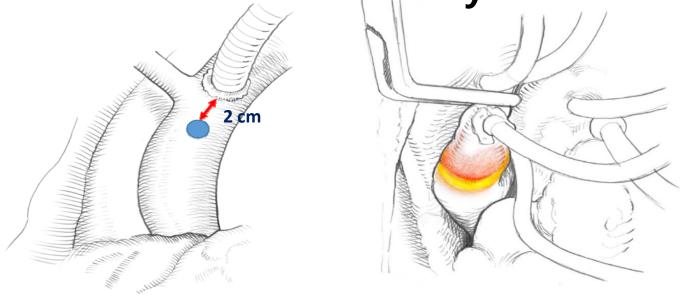
- Use of sutureless and rapid deployment valves together with minimally invasive approaches in patients requiring biological valve replacement and not serving as candidates for TAVI
- Use of sutureless and rapid deployment valves are recommend in order to reduce extracorporeal circulation and aortic cross-clamp time
- 3. Suitable annular sizes (after decalcification) of 19 to 27 mm
- Oversizing with sutureless valves is not beneficial and can have negative impact
- Contraindication for annular abscess or destruction due to infective endocarditis
- 6. Contraindication for bicuspid valve type 0
- Implantation possible in bicuspid valves type 1 and 2 if a. coronary ostia do not have 180-degree position,
- b. round annulus, and
- c. uniform height of the commissures (type 2).
- 8. Use of sutureless and rapid deployment valves reduces early complications as prolonged ventilation, blood transfusion, atrial fibrillation, pleural effusions, paravalvular leakages and aortic regurgitation, and renal replacement therapy, respectively
- Use of sutureless and rapid deployment valves results in reduced ICU and hospital stay
- Use of sutureless and rapid deployment valves will lead to a higher adoption rate of minimally invasive approaches in aortic valve replacement
- Take respect to necessary, brief learning curves for both sutureless and minimally invasive programs

- Contraindication for annular abscess or destruction due to infective endocarditis
- 6. Contraindication for bicuspid valve type 0



**Aortic cannulation & Aortotomy** 

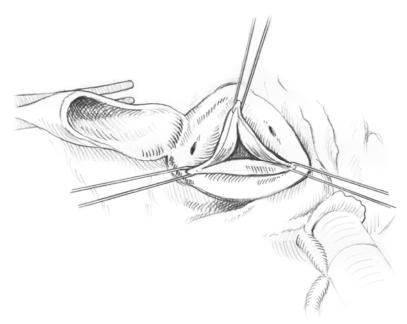
annulus



- It is recommendable to perform the aortic cannulation in the arch 2 cm more distally than usual, leaving 2-3 cm between cross clamp and the aortotomy, as shown in the picture. (Find yellow fat band!!!!)
- A transverse aortotomy located at <u>least 3.5 cm above the aortic</u>

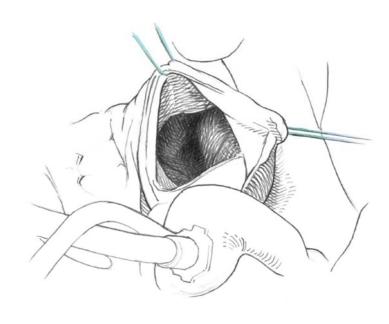
#### **Decalcification**

#### Traction suture in commissure



Just transverse, not hockey stick

#### **Careful decalcification**



Ensure that the aorto-mitral curtain remains intact

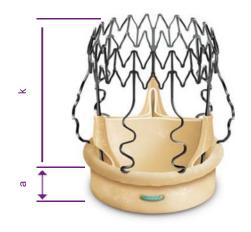


## Decalcification

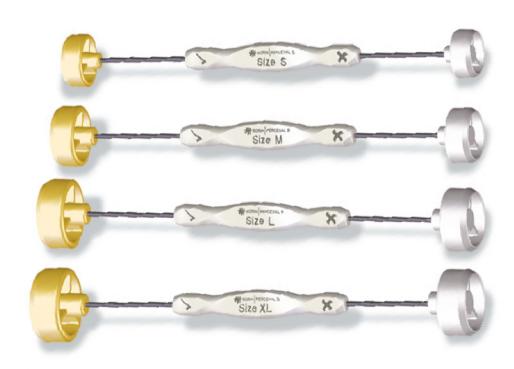




# Sizing is most important



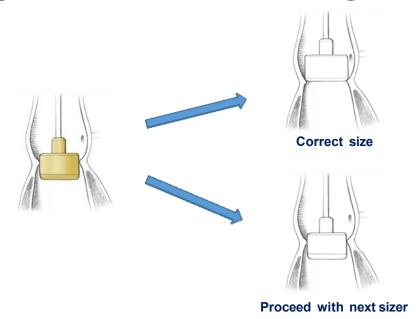
Size	S	M	L	XL
a (mm)	6.0	6.5	7.0	8.0
k (mm)	25	26.5	28.5	29.5





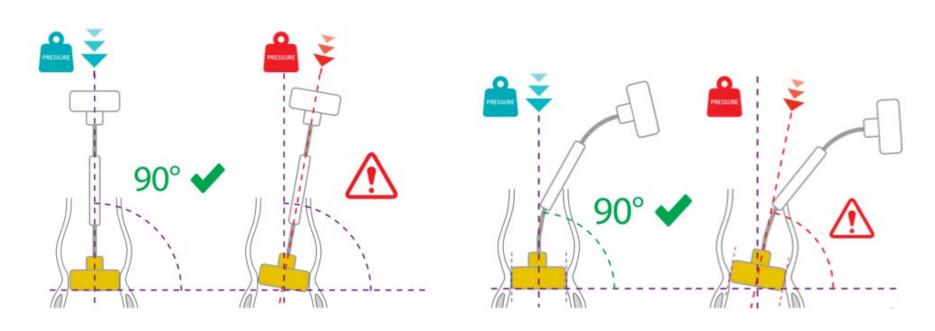
### Sizing is most important

- ✓ Yellow obturator passes easily through the aortic annulus
- ✓ White obturator remains stable above the aortic annulus
- ✓ Avoid forcing the white obturator through the annulus



### Sizing is most important

### Perpendicular alignment





# Sizing is most important : AVOID OVERSIZING

#### **Effects of oversizing on Perceval EOA**

100% 94% 80%







1Size Oversizing

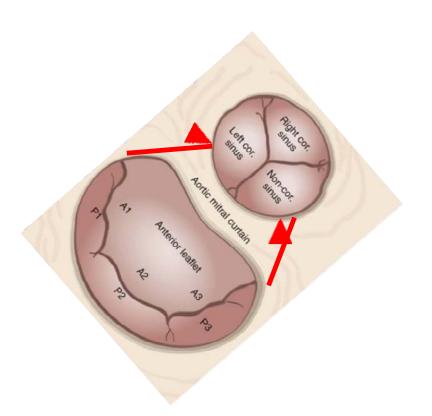


2 Sizes Oversizing

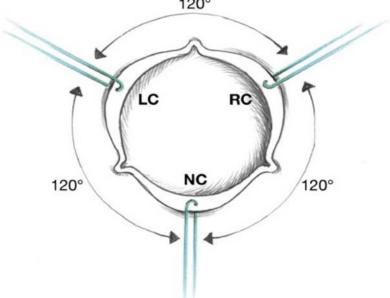
If you can see the coaptation line looked like seagull, it is maybe wrong size valve



### **Guiding sutures**

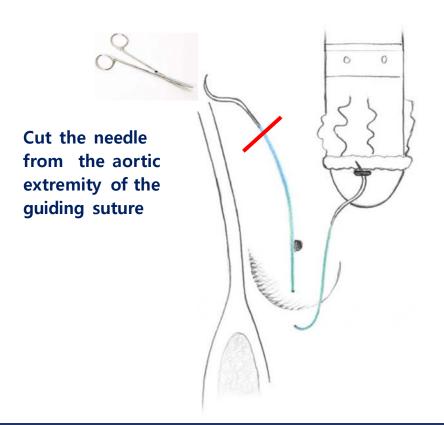


- **√** 3 Nadir position
- ✓ For beginner, sizer is recommended
- ✓ Check MV relationship with AV

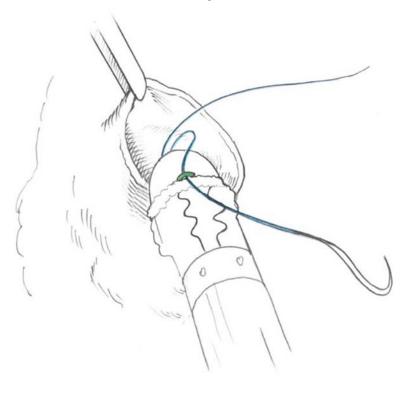




### **Guiding sutures**



The needle of the LVOT extremity must be inserted in the eyelets





### **Guiding sutures**

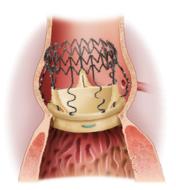
### : DO NOT TIE GUIDING SUTURES

#### Tying Guiding Sutures can impair Valve Performance

**Uneven expansion (distorted valve)** 

Sub-optimal seating (tilted valve)

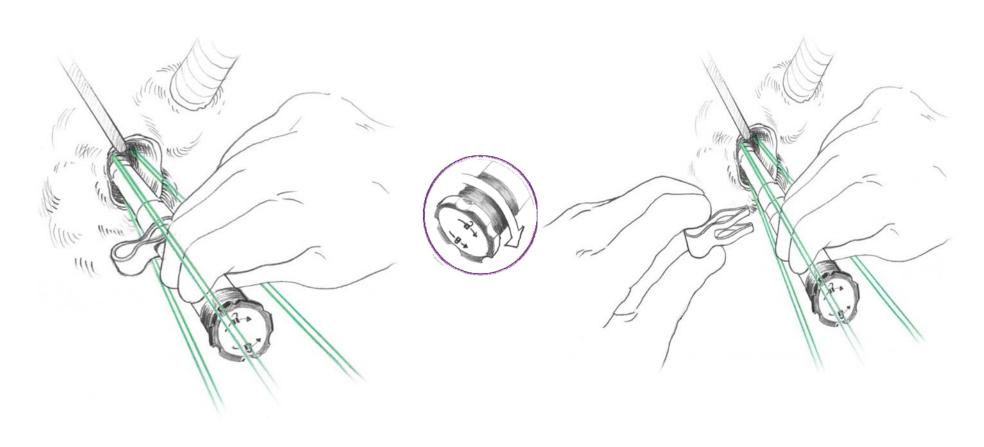




NO need to tie the guiding sutures: Perceval is very stable in the aortic root. There is only one published case of migration, and only one reported in the Perceval clinical studies due to initial malpositioning.

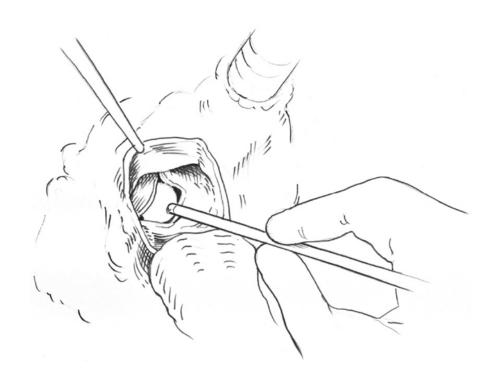


# Valve positioning

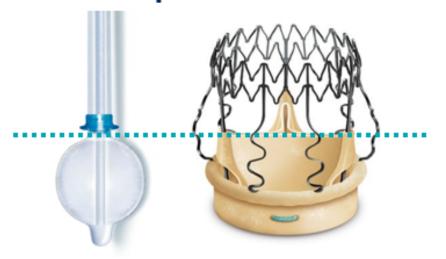




### **Balloon**

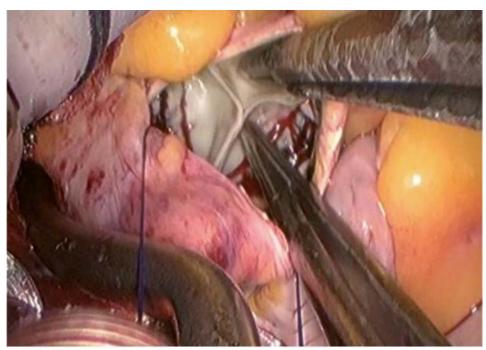


## 90` to the plane of the annulus

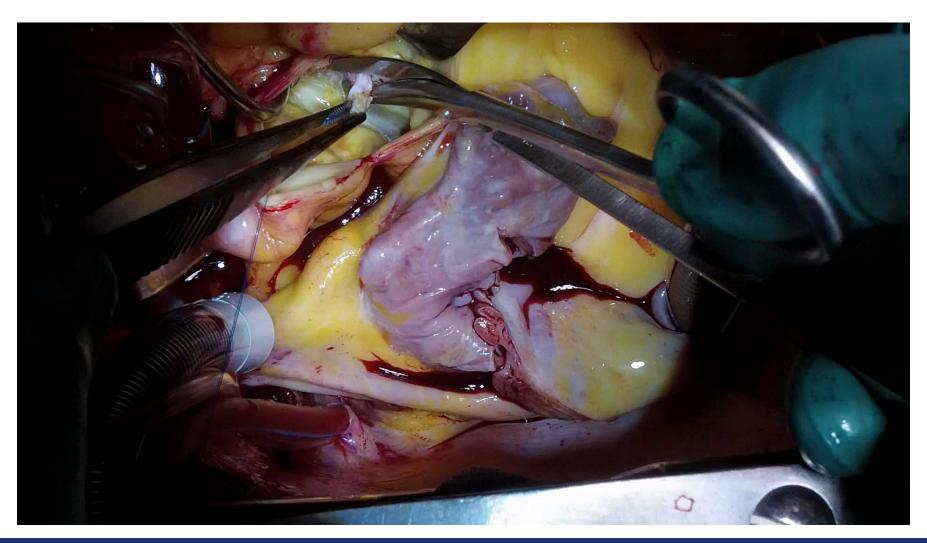


# Valve positioning & cooptation











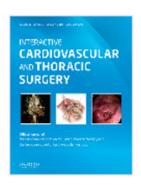
# Sutureless AVR vs. TAVR



# CARDIOVASCULAR AND THORACIC SURGERY





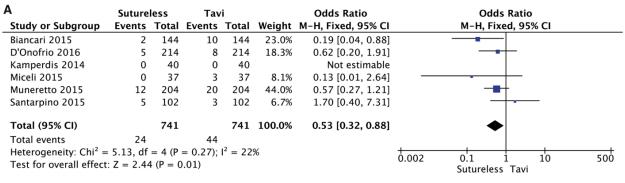


Volume 26, Issue 2 February 2018 Sutureless aortic valve replacement versus transcatheter aortic valve implantation: a metaanalysis of comparative matched studies using propensity score matching ••

Massimo Meco, Antonio Miceli, Andrea Montisci ▼, Francesco Donatelli, Silvia Cirri, Matteo Ferrarini, Antonio Lio, Mattia Glauber Author Notes

Interactive CardioVascular and Thoracic Surgery, Volume 26, Issue 2, 1 February 2018, Pages 202–209, https://doi.org/10.1093/icvts/ivx294





#### **Postoperative mortality**

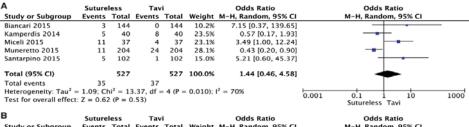
В	Suture	less	Tav	i		Odds Ratio		Odds Ratio	
Study or Subgroup	Events	Total	<b>Events</b>	Total	Weight	M-H, Fixed, 95% CI	M	-H, Fixed, 95% C	
Biancari 2015	0	144	3	144	12.7%	0.14 [0.01, 2.73]		•	
D'Onofrio 2016	4	214	4	214	14.3%	1.00 [0.25, 4.05]		<del></del>	
Kamperdis 2014	2	40	1	40	3.5%	2.05 [0.18, 23.59]		-	_
Miceli 2015	0	37	2	37	9.0%	0.19 [0.01, 4.08]		-	
Muneretto 2015	3	204	12	204	43.0%	0.24 [0.07, 0.86]	_	-	
Santarpino 2015	3	102	5	102	17.6%	0.59 [0.14, 2.53]			
Total (95% CI)		741		741	100.0%	0.45 [0.23, 0.88]		•	
Total events	12		27						
Heterogeneity: Chi <sup>2</sup> =	4.69, df	= 5 (P	= 0.45);	$I^2 = 0\%$			0.001 0	1 1 10	1000
Test for overall effect	Z = 2.32	2 (P = 0)	).02)					ureless Tavi	1000

#### **Postoperative stroke**

С	Suture	less	TAV	/I		Risk Ratio	Risk	Ratio	
Study or Subgroup	<b>Events</b>	Total	<b>Events</b>	Total	Weight	M-H, Fixed, 95% CI	M-H, Fixe	ed, 95% CI	
Miceli 2015	0	37	10	37	7.9%	0.05 [0.00, 0.78]	<del>-</del>		
D'Onofrio 2016	1	204	14	204	10.5%	0.07 [0.01, 0.54]	<del>-</del>		
Muneretto 2015	4	204	18	204	13.5%	0.22 [0.08, 0.65]			
Biancari 2015	1	144	21	144	15.7%	0.05 [0.01, 0.35]	•		
Kamperdis 2014	8	40	35	40	26.2%	0.23 [0.12, 0.43]			
Santarpino 2015	7	102	35	102	26.2%	0.20 [0.09, 0.43]	_		
Total (95% CI)		731		731	100.0%	0.16 [0.11, 0.25]	•		
Total events	21		133						
Heterogeneity: Chi <sup>2</sup> =	4.63, df	= 5 (P	= 0.46);	$I^2 = 0\%$			0.01	10	100
Test for overall effect	Z = 8.43	3 (P < 0	0.00001)				0.01 0.1 Favours [experimental]	1 10 Favours [control]	100

Postoperative aortic regurgitation





В	B Sutureless		Tav	/i		Odds Ratio	Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
Biancari 2015	16	144	22	144	24.0%	0.69 [0.35, 1.38]	
D'Onofrio 2016	20	214	6	214	19.9%	3.57 [1.41, 9.09]	
Kamperdis 2014	1	40	3	40	6.7%	0.32 [0.03, 3.18]	
Miceli 2015	2	37	0	37	4.2%	5.28 [0.24, 113.87]	<del></del>
Muneretto 2015	20	204	30	204	25.6%	0.63 [0.35, 1.15]	
Santarpino 2015	10	102	9	102	19.7%	1.12 [0.44, 2.89]	<del>-</del>
Total (95% CI)		741		741	100.0%	1.06 [0.54, 2.08]	<b>+</b>
Total events	69		70				
Heterogeneity: Tau <sup>2</sup> =	= 0.36; CI	$hi^2 = 12$	2.58, df :	= 5 (P =	0.03); I2	= 60%	0.002 0.1 1 10 500
Test for overall effect	z = 0.13	8 (P = 0	0.86)				Sutureless Tavi

С	Suture	less	Tav	ri .		Odds Ratio	Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI	M-H, Fixed, 95% CI
Biancari 2015	6	144	0	144	2.7%	13.56 [0.76, 243.04]	<del></del>
D'Onofrio 2016	2	38	1	38	5.3%	2.06 [0.18, 23.68]	<del></del>
Kamperdis 2014	7	40	1	40	4.7%	8.27 [0.97, 70.73]	
Muneretto 2015	73	204	24	202	87.3%	4.13 [2.47, 6.91]	— <del>—</del>
Total (95% CI)		426		424	100.0%	4.47 [2.77, 7.21]	•
Total events	88		26				
Heterogeneity: Chi <sup>2</sup> =	1.36, df	= 3 (P	= 0.71);	$I^2 = 0\%$	5		0.1 0.2 0.5 1 2 5 10
Test for overall effect	: Z = 6.1	3 (P < 0)	0.00001)				0.1 0.2 0.5 1 2 5 10 Sutureless Tavi

D	Suture	less	Tav	d		Odds Ratio	Odds Ratio
Study or Subgroup	Events		Events		Weight	M-H, Random, 95% CI	M-H, Random, 95% CI
Biancari 2015	0	144	15	144	26.9%	0.03 [0.00, 0.49]	
D'Onofrio 2016	0	0	0	0		Not estimable	
Kamperdis 2014	0	40	1	40	20.6%	0.33 [0.01, 8.22]	-
Muneretto 2015	0	204	20	204	27.1%	0.02 [0.00, 0.37]	
Santarpino 2015	0	102	5	102	25.4%	0.09 [0.00, 1.58]	
Total (95% CI)		490		490	100.0%	0.06 [0.01, 0.25]	•
Total events	0		41				
Heterogeneity: Tau <sup>2</sup> =	0.00; Ch	$hi^2 = 2.$	02, df =	3 (P =	$0.57$ ; $I^2 =$	0%	0.001 0.1 1 10 1000
Test for overall effect	: Z = 3.80	0 (P = 0	).0001)				Sutureless Tavi

	Sutureless				Γavi			Mean Difference	Mean Difference		
Study or Subgroup	Mean			Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI		
D'Onofrio 2016	2	1	206	3.2	2	206	26.5%	-1.20 [-1.51, -0.89]	-		
Miceli 2015	1	1	40	1	1	40	25.7%	0.00 [-0.44, 0.44]	*		
Muneretto 2015	1.6	2.3	204	3.2	2	204	25.8%	-1.60 [-2.02, -1.18]	•		
Santarpino 2015	3.2	3.5	102	2.2	2.7	102	22.0%	1.00 [0.14, 1.86]	-		
Total (95% CI)			552			552	100.0%	-0.51 [-1.42, 0.40]	<b>→</b>		
Heterogeneity: Tau² =	0.79; (	chi² =	49.51	, df = 3	(P <	0.000	01); $I^2 = 9$	94% -	4 5 6 3 4		
Test for overall effect:	Z = 1.1	LO (P	= 0.27	)					Favours Sutureless Favours TAVI		

postoperative renal failure

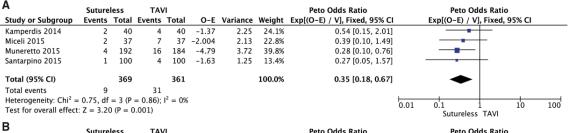
postoperative pacemaker implantation

postoperative blood transfusions

postoperative vascular complications

postoperative intensive care unit stay





1-year mortality

В	Suture	Sutureless TAVI		Peto Odds Ratio		Peto Odds Ratio	Peto Odds Ratio				
Study or Subgroup	Events	Total	Events	Total	O-E	Variance	Weight	Exp[(O-E) / V], Fixed, 95% CI	E	xp[(O-E) / V], Fixe	d, 95% CI
Kamperdis 2014	0	27	0	30	-0.54	2.26	40.1%	0.79 [0.21, 2.90]		_	
Miceli 2015	0	10	3	21	-0.157	0.059	1.0%	0.07 [0.00, 223.19]	$\leftarrow$	<del></del>	
Muneretto 2015	2	125	9	109	-3.46	2.16	38.3%	0.20 [0.05, 0.76]		-	
Santarpino 2015	0	83	3	77	-1.32	1.16	20.6%	0.32 [0.05, 1.98]		<del></del>	
Total (95% CI)		245		237			100.0%	0.38 [0.17, 0.86]		•	
Total events	2		15								
Heterogeneity: Chi <sup>2</sup> =	= 2.27, df	= 3 (P)	= 0.52);	$I^2 = 0\%$					0.001	0.1	10 1000
Test for overall effect	z = 2.31	1 (P = 0)	0.02)						0.001	Sutureless TAV	

2-year mortality

С	Suture	less	TAV	<b>/</b> I		Odds Ratio	Odds Ratio	
Study or Subgroup	<b>Events</b>	Total	<b>Events</b>	Total	Weight	M-H, Fixed, 95% CI	I M-H, Fixed, 95% CI	
3.5.1 2 years follow-	up of pa	tients	without	AR				-
Muneretto 2015	6	192	25	184	30.1%	0.21 [0.08, 0.51]	]	
Santarpino 2015 Subtotal (95% CI)	1	100 <b>292</b>	7	100 <b>284</b>	8.4% <b>38.6%</b>			
Total events	7		32					
Heterogeneity: Chi <sup>2</sup> =	0.13, df	= 1 (P)	= 0.72);	$I^2 = 0\%$				
Test for overall effect:	Z = 3.88	B (P = 0)	0.0001)					
3.5.2 2 years follow- Muneretto 2015 Santarpino 2015	up of pa 6 1	192 100		184 100	50.6% 10.8%	0.10 [0.01, 0.82]	j <u> </u>	
Subtotal (95% CI)	_	292		284	61.4%	0.11 [0.05, 0.24]		
Total events Heterogeneity: Chi <sup>2</sup> = Test for overall effect:	,	•		$I^2 = 0\%$				
Total (95% CI)		584		568	100.0%	0.14 [0.08, 0.25]	1 •	
Total events Heterogeneity: Chi <sup>2</sup> = Test for overall effect: Test for subgroup diff	Z = 6.64	(P < 0	0.00001)	0.01 0.1 1 10 100 Sutureless TAVI				

meta-analysis of studies assessing the effect of postoperative aortic regurgitation on 2-year mortality







