



Replacement of the Ascending Aorta in Early Childhood: Surgical Strategies and Long-Term Outcome

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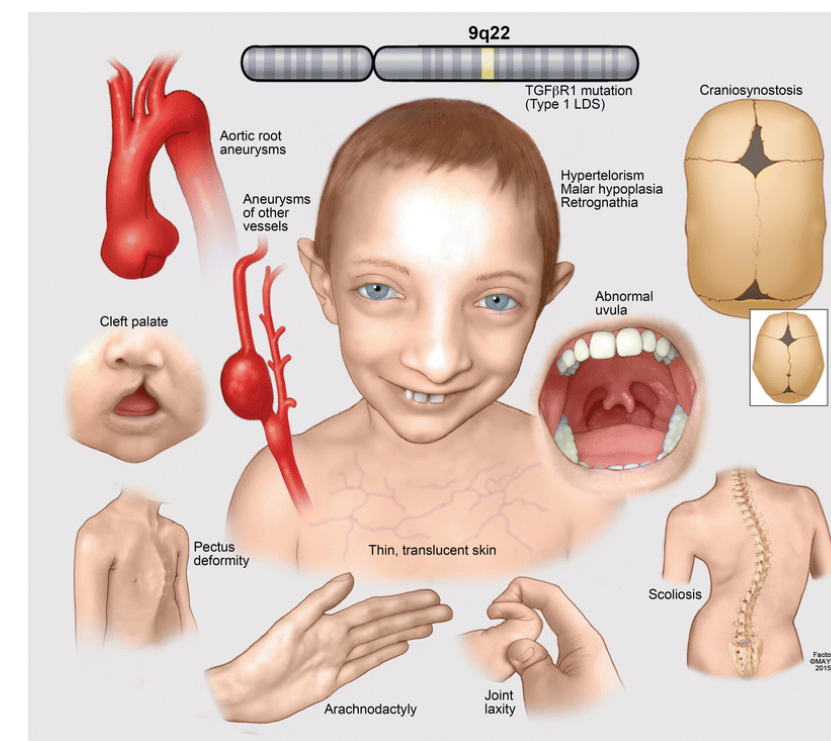
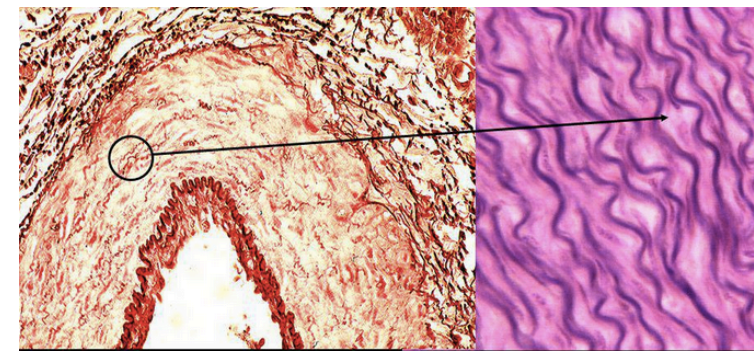
I have no conflict of interest to declare

Background

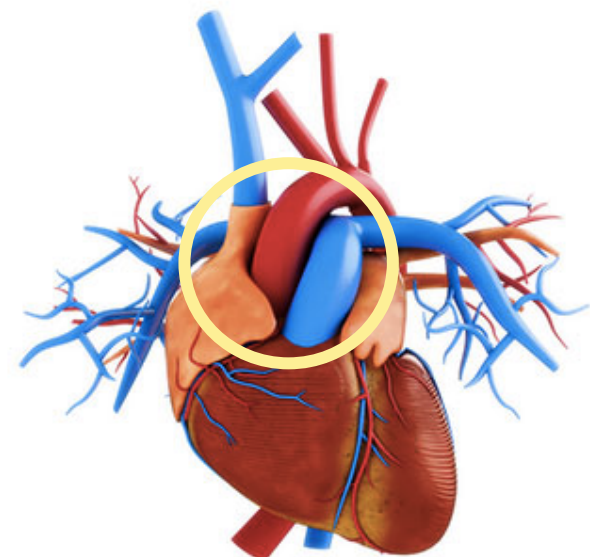
Aortic root dilatation: rare in young children



Connective Tissue Diseases



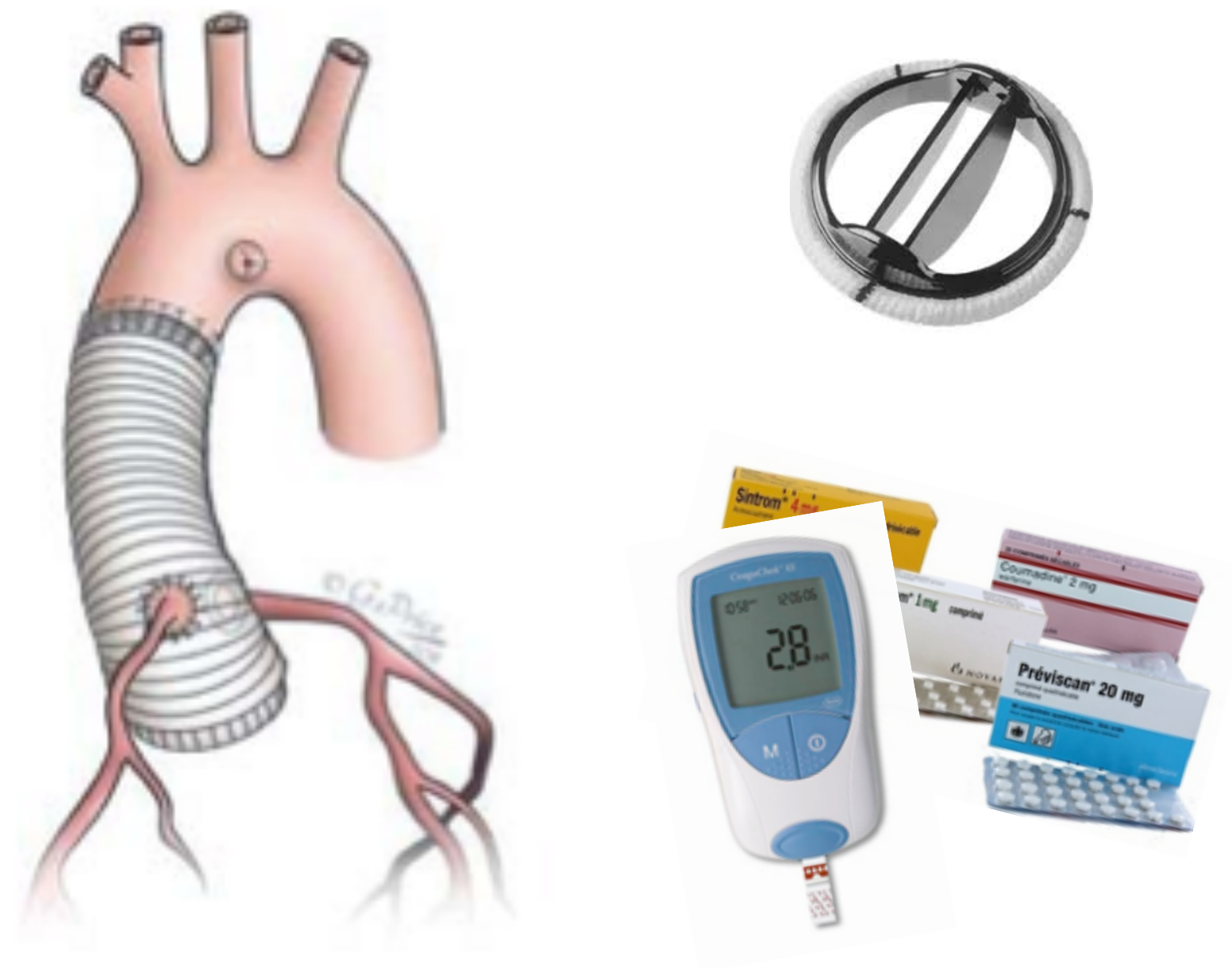
Isolated Congenital Heart Diseases



Background

Ascending Aorta Replacement: surgical techniques

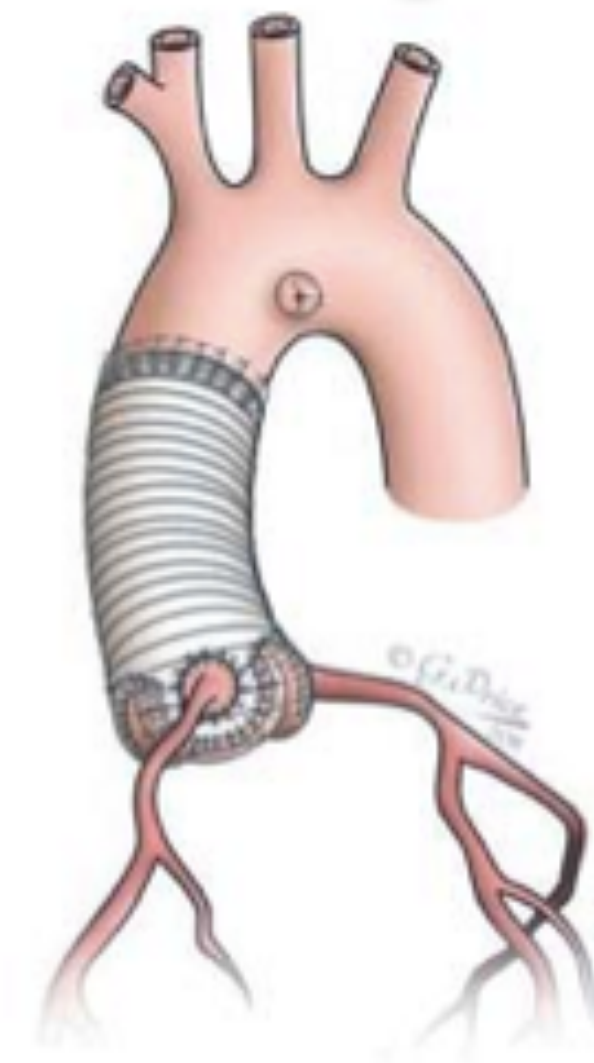
Composite graft procedure



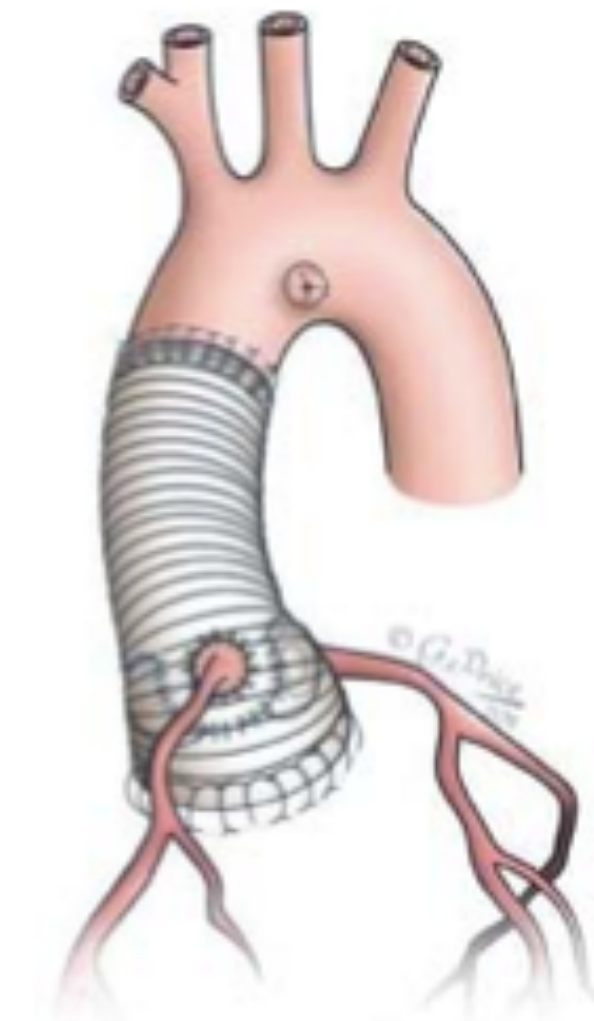
Pictures from Michael Gatzoulis

Valve-sparing procedures

Remodeling technique (Yacoub)



Reimplantation technique (David)



[J Am Coll Cardiol. 2016 Oct 25;68\(17\):1838-1847. doi: 10.1016/j.jacc.2016.07.767.](#)

Valve-Sparing Root Rep With Aortic Root Dilatio

[Ouzounian M¹, Rao V², Manlihot C², A](#)

[Ann Cardiothorac Surg. 2017 Nov;6\(6\):570-581. doi: 10.21037/acs.2017.11.06.](#)

Systematic review a root surgery by com

[Flynn CD¹, Tian DH², Wilson-Sn](#)

[Ann Thorac Surg. 2004 Sep;78\(3\):767-72; discussion 767-72.](#)

Results of aortic valve-sparing operations: experience with remodeling and reimplantation procedures in 65 patients.

[Bethea BT¹, Fitton TP, Alejo DE, Barreiro CJ, Cattaneo SM, Dietz HC, Spevak PJ, Lima JA, Gott VL, Cameron DE.](#)



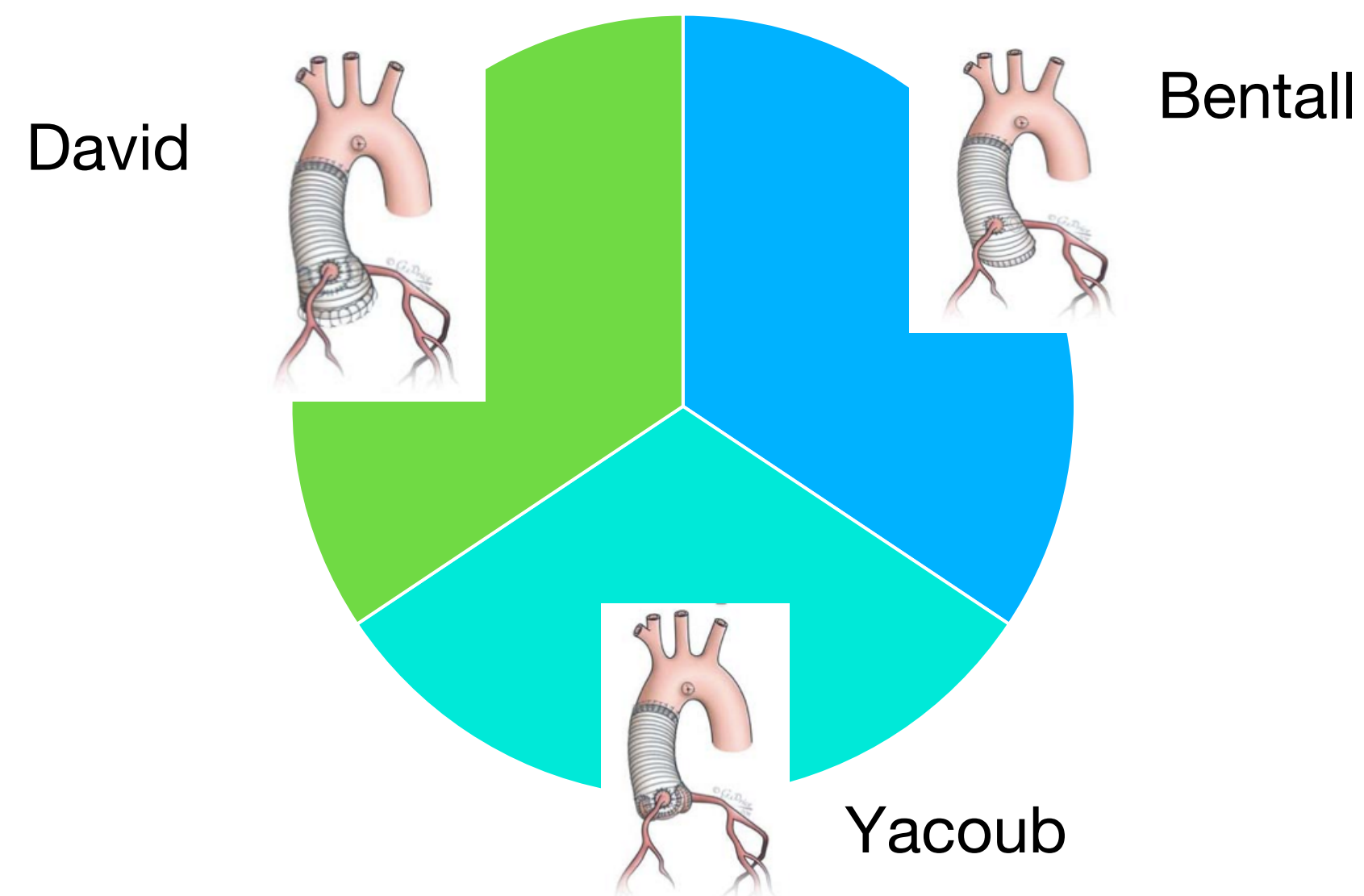
Methods

- **Retrospective study** in Necker hospital (Paris, France) between 1995 and 2017
- Ascending aorta replacement (AAR): **32 children < 10 year-old**
 - *Median age* : 5.3 years (range, 7 months to 9.7 years)
 - *Median weight* : 18 kg (range, 5.8 to 55 kg)
- Main **population features**
 - n = 22 (69%) had a connective tissue disease
 - n = 7 (22%) had undergone a neonatal surgery including outflow tract (Ross procedure, arterial switch operation,...)
 - n = 10 (31%) associated a bicuspid aortic valve

Methods

AAR procedures

- n = 11 composite mechanical valve graft procedures (Bentall operations)
- n = 21 valve-sparing procedures
 - n = 10 remodeling procedures (Yacoub operations)
 - n = 11 reimplantation procedures (David operations)



Methods-Population

AAR procedures

Characteristics	Bentall n = 11	David n = 11	Yacoub n = 10	p Value
Mean age (years)	6.8 +/- 2.8	5.3 +/- 2.4	3.8 +/- 2.6	0.052
Mean weight (kg)	21.1 +/- 6.6	20.2 +/- 12.7	14.1 +/- 6.9	ns
Male	9 (82%)	6 (55%)	6 (60%)	ns
IMS	1 (9%)	5 (45%)	9 (90%)	0.001
Preoperative AR > 1+	10 (91%)	3 (27%)	2 (20%)	0.002
Preoperative aortic root (mm)	36.3 +/- 7.6	39.3 +/- 6.4	37.8 +/- 6.3	ns
Preoperative aortic root Z-score	+5.9 +/- 2.1	+7 +/- 1.5	+7.6 +/- 1.7	ns
Previous cardiac surgery	7 (64%)	0	3 (30%)	0.003
Mean cross-clamp time (min)	112 +/- 33	112 +/- 22	114 +/- 52	ns
Associated surgery	4 (36%)	6 (55%)	3 (30%)	ns
Mean aortic root graft (mm)	22.4 +/- 1.2	21.1 +/- 3.3	17.5 +/- 2.6	0.002

Table 1: Patients and operative data according to the ascending aorta procedure

Table 2: Patients and operative data according to the underlying congenital disease

Characteristics	IMS n = 15	LDS n = 7	Others n = 10	p Value
Mean age (years)	4.4 +/- 2.5	4.4 +/- 2.9	7.5 +/- 2.3	0.017
Mean weight (kg)	18.6 +/- 12.4	14.7 +/- 6.6	22.3 +/- 5.7	0.05
Male	10 (67%)	2 (29%)	9 (90%)	0.035
Preoperative AR > 1+	3 (20%)	3 (43%)	9 (90%)	0.002
Preoperative aortic root (mm)	40.2 +/- 7.4	36.9 +/- 4.6	34.9 +/- 6.1	ns
Preoperative aortic root Z-score	+7.5 +/- 1.5	+7.4 +/- 1.6	+5.3 +/- 1.8	0.026
Previous cardiac surgery	2 (13%)	0	8 (80%)	0.003
Aortic valve sparing procedure	14 (93%)	5 (71%)	2 (20%)	<0.001
Mean cross-clamp time (min)	121 +/- 40	96 +/- 15	115 +/- 32	ns
Associated surgery	6 (40%)	2 (29%)	5 (50%)	ns
Mean aortic root graft (mm)	19.4 +/- 3.6	20.6 +/- 3.2	22.2 +/- 1.5	ns

IMS = Infantile Marfan Syndrome, LDS = Loeys-Dietz syndrome, AR = Aortic Regurgitation, ns = no significant

Results (1): Mortality

- No operative death
- Cardiac-related mortality: n = 2 patients (6%)
 - Related with left ventricular failure
 - 1 patient with a coronary injury during surgery
 - 1 patient with a secondary unexplained dilated cardiomyopathy
- One-year and **ten-year patient survivals: 91 %**

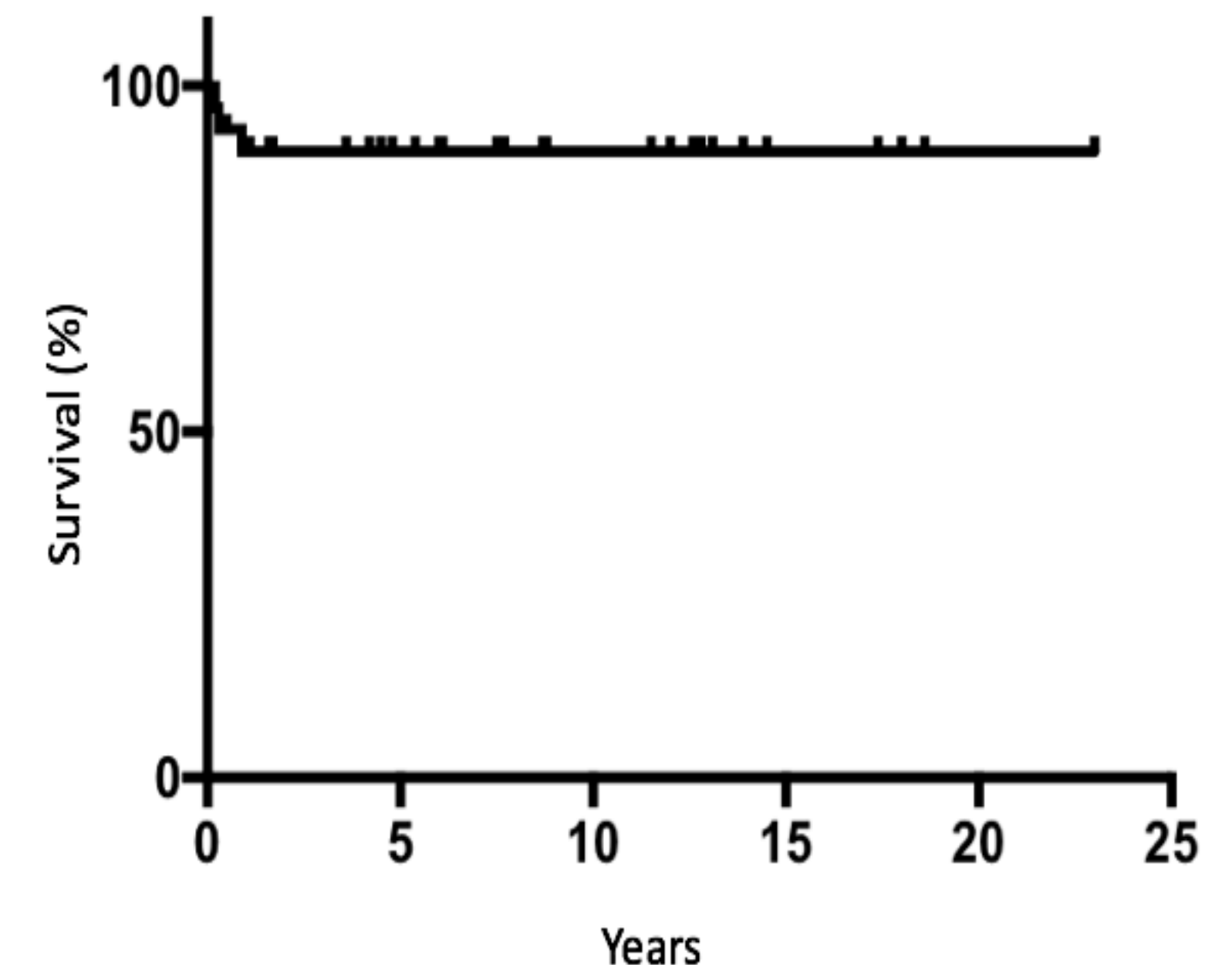


Figure 1: Kaplan-Meier survival after AAR in children < 10 year-old

Results (2): Risk factors of Mortality

Risk Factors	Alive n = 29	Cardiac-related deaths n = 2	<i>p</i> Value
Male	19 (66%)	1	ns
Mean age	5.6 +/- 2.8 y	3.2 +/- 2.5 y	ns
Mean weight	19.6 +/- 9.8 kg	12.2 +/- 4 kg	ns
Zscore	6.7 +/- 1.8	9.3 +/- 1	0.048
IMS syndrome	13 (45%)	2	ns
Connective tissue disease	19 (66%)	2	ns
Aortic regurgitation	13 (45%)	1	ns
Non-tricuspid aortic valve	12 (41%)	1	ns
Associated surgery	11 (38%)	2	ns
Previous surgery	9 (31%)	1	ns
Valve-sparing procedure	19 (66%)	2	ns
Cross-clamp time	110 +/- 26 min	169 +/- 76 min	ns

Table 3: Cardiac-related mortality risk factors

IMS: Infantile Marfan Syndrome, ns = no significant

Results (3): Reintervention

- n = 29 survivors
- Median follow-up for survivors = 7.7 years (range, 6 months to 23 years)
- Reintervention: n = 11 (38%) after a median time of 4.2 years
 - Required by **aortic regurgitation after initial valve-sparing procedure**
- One-year and ten-year **freedom from reintervention**: 96% and 51%

Patient	Connective Tissue Disorder	Age (years)	Surgery	Aortic root graft #1 (mm)	Reop. Delay (years)	Aortic root graft #2 (mm)
1	IMS	0.8	Yacoub	-	11.1	24
2	IMS	4.8	Yacoub	20	5.0	24
3	IMS	4.6	Yacoub	14	2.0	22
4	-	9.3	Yacoub	20	0.7	22
5	IMS	2.8	Yacoub	-	4.4	28
6	IMS	6.2	Yacoub	18	4.0	24
7	IMS	3.4	Yacoub	16	5.0	24
8	IMS	5.0	David	20	4.1	22
9	IMS	4.5	David	22	1.6	24
10	IMS	4.2	David	19	8.1	28
11	IMS	9.7	David	24	2.1	28

Table 4: Surgical and demographic features of the patients who required a reintervention with aortic valve replacement by a mechanical prosthesis

Results (4): Risk factors of Reintervention

Risk Factors	Reoperation n = 11	No-reoperation n = 18	p Value
Male	8 (73%)	11 (61%)	ns
Mean age	5 +/- 2.6 y	5.9 +/- 3 y	ns
Mean weight	21.6 +/- 14 kg	18.6 +/- 7.2 kg	ns
Zscore	6.9 +/- 1.7	6.6 +/- 1.9	ns
IMS	10 (91%)	3 (17%)	0.017
Aortic regurgitation	2 (18%)	11 (61%)	ns
Non-tricuspid aortic valve	4 (36%)	8 (44%)	ns
Valve-sparing procedure	11 (100%)	8 (44%)	0.0024
<i>Yacoub procedure vs David procedure</i>			
	7 (64%)	2 (25%)	ns
<i>IMS</i>			
	10 (91%)	2 (25%)	ns

Table 5: Reoperation risk factors

IMS: Infantile Marfan Syndrome, ns = no significant

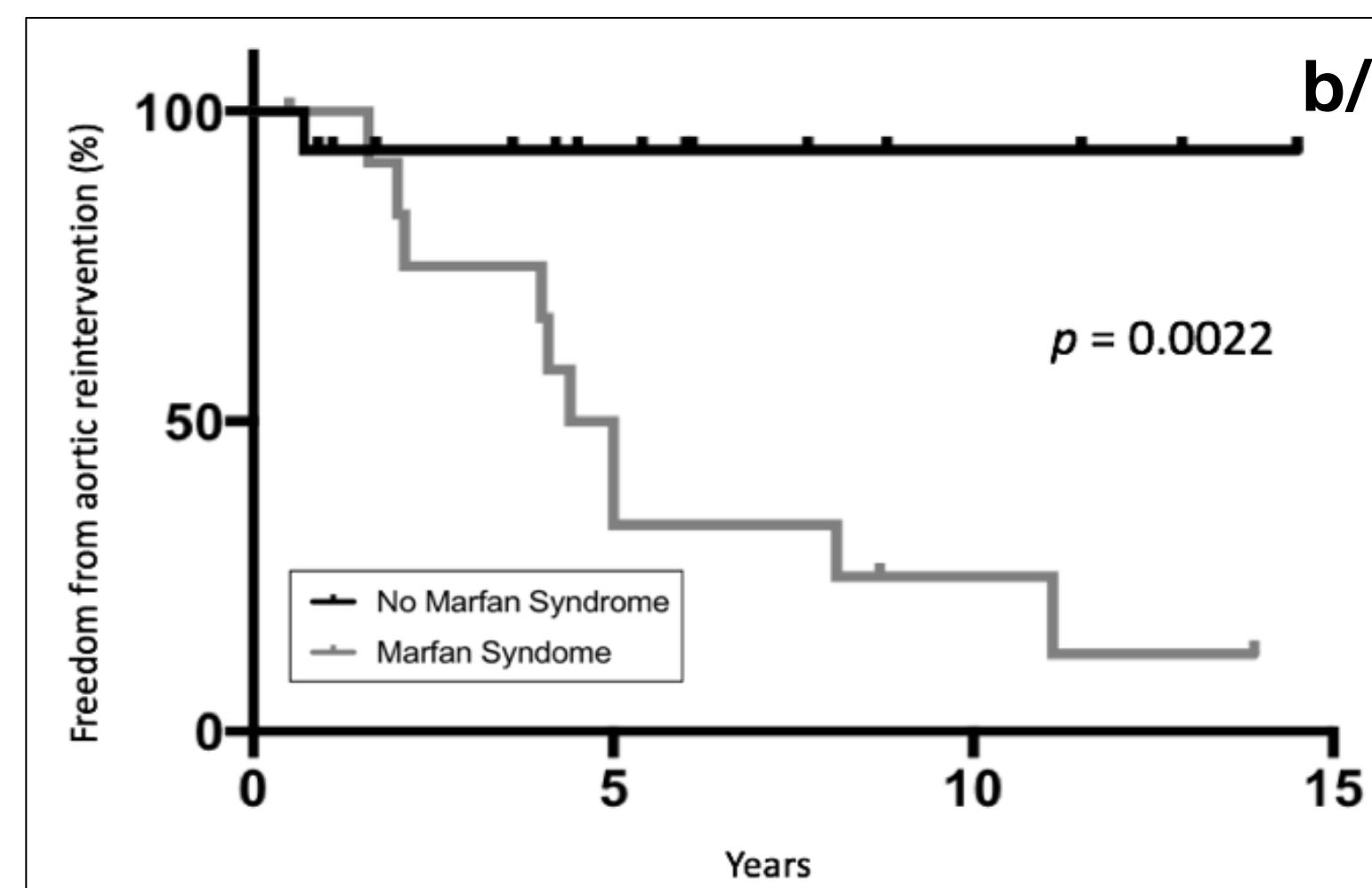
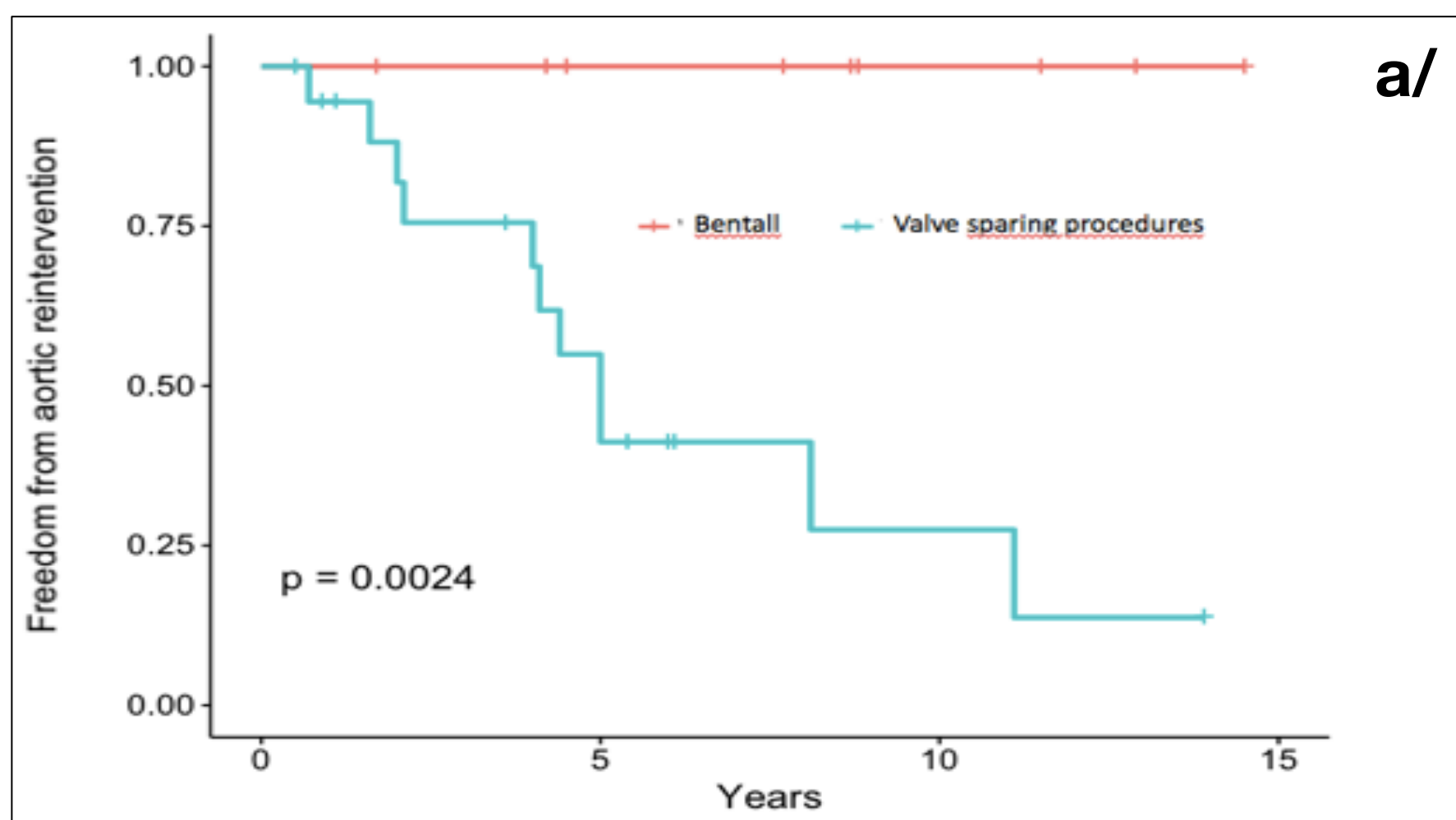


Figure 1: Kaplan Meier curves according to
a/ surgical procedure
b/ underlying IMS

Conclusions

- **Acceptable** long-term outcome, **low late mortality**
- **Bentall procedure** is safe and durable
- Data would suggest death is related with greater aortic root Zscore
- Special surgical strategy for IMS with subsequent unavoidable aortic regurgitation



Thank you



