

Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

Table e1. Baseline and surgical characteristics per center

		Australia	Belgium	Brazil	Canada	Germany
		Average ± sd or n (%)				
Patients (n)	1431	201	174	316	112	628
Age (years)	47.7 ± 9.5	50.6±6.4	48.8±5.1	49.3±6.1	53.0±6.2	44.7±11.9
<20	20	0 (0)	0 (0)	0 (0)	0 (0)	20 (3.2)
20 – 40	192	1 (0.5)	1 (0.6)	2 (0.6)	0 (0)	188 (29.9)
40 – 60	1114	183 (91.0)	170 (97.7)	295 (97.7)	98 (87.5)	368 (58.6)
>60	105	17 (8.5)	3 (1.7)	19 (1.7)	14 (12.5)	52 (8.3)
Males (n)	1064 (74.3)	133 (66.2)	132 (75.9)	231 (73.1)	91 (81.3)	477 (76.0)
NYHA classification (n = 1426)						
I	373 (26.1)	22 (11.0)	46 (26.4)	101 (32.3)	17 (15.2)	187 (29.8)
II	724 (50.8)	134 (67.0)	77 (44.3)	138 (44.1)	51 (45.5)	324 (51.7)
III	315 (22.1)	42 (21.0)	49 (28.2)	67 (21.4)	44 (39.3)	113 (18.0)
IV	14 (1.0)	2 (1.0)	2 (1.1)	7 (2.2)	0 (0)	3 (0.5)
Hypertension (n=1167)	374 (32.0)	NA	46 (41.4)	83 (26.3)	40 (35.7)	205 (32.6)
Diabetes (n=1055)	43 (4.1)	NA	NA	6 (1.9)	8 (7.2)	29 (4.6)
Coronary artery disease (n= 1056)	52 (4.9)	NA	NA	3 (0.9)	12 (10.7)	37 (5.9)
Chronic obstructive lung disease (n = 1056)	21 (2.0)	NA	NA	2 (0.6)	7 (6.3)	12 (1.9)
Congestive heart failure (n=1230)	15 (1.2)	NA	5 (2.9)	1 (2.9)	3 (2.7)	6 (1.0)
Dyslipidemia (n = 1056)	223	NA	NA	62 (19.6)	37 (33.0)	124 (19.7)
Peripheral arterial disease (n = 1056)	5 (0.5)	NA	NA	1 (0.3)	1 (0.9)	3 (0.5)
Aortic valve morphology (n=1022)		NA	NA			
Bicuspid	778 (76.1)			238 (81.5)	83 (74.1)	457 (74.0)
Tricuspid	191 (18.7)			38 (13.0)	13 (11.6)	140 (22.6)
Other/prosthetic	53 (5.2)			16 (0.5)	16 (14.3)	21 (3.4)
Concomitant procedures						
CABG (n = 1230)	45 (3.7)	NA	14 (8.0)	3 (0.9)	12 (10.7)	16 (2.5)
Previous cardiac surgery	85 (5.9)	8 (4.0)	22 (12.6)	13 (4.1)	10 (8.9)	32 (5.1)
Echocardiographic						
LVEDD (mm) (n=1198)	53±9.5	52.4±8.5	54.6±8.1	53.9±10.0	50.6±7.4	53.6±10.3
LVESD (mm) (n=1127)	34±8.5	33.4±7.7	34.2±7.6	34.9±8.8	32.7±7.8	33.6±8.9
LVEF (%) (n=967)	66±11.5	NA	63.8±9.0	70.4±14.2	61.4±7.0	65.5±10.6
Aorta valve Peak Gradient (mmHg)	70±33	NA	78.1±32.4	76.2±26.5	73.6±35.0	64.0±35.0
Aorta valve Mean Gradient (mmHg)	44±21	49.8±16.6	51.7±20.9	48.3±16.6	48.3±20.3	37.2±21.8
Aortic valve regurgitation (n = 1117)		NA				
Aortic regurgitation – no	141 (12.6)		53 (30.5)	17 (6.3)	21 (19.1)	50 (8.9)
Aortic regurgitation – trace	363 (32.5)		31 (17.8)	132 (48.9)	51 (46.3)	148 (26.3)
Aortic regurgitation – mild	237 (21.2)		36 (20.7)	52 (19.3)	21 (19.1)	128 (22.7)
Aortic regurgitation – moderate	278 (24.9)		48 (27.6)	0 (0)	11 (10.0)	219 (38.9)
Aortic regurgitation – severe	98 (8.8)		6 (3.4)	69 (25.5)	6 (5.5)	18 (3.2)
Technique (n=1427)						
Root inclusion	355 (24.9)	199 (99.0)	82 (47.1)	41 (13.1)	0 (0)	33 (5.3)
Root replacement	485 (34.0)	1 (0.5)	86 (49.4)	271 (87.9)	112 (100)	15 (2.4)
Subcoronary	587 (41.1)	1 (0.5)	6 (3.5)	0 (0)	0 (0)	580 (93.3)
CPB time (min) (n=1313)	198 ± 41	198±22	154±33	182±41	214±39	218±34
Cross-clamp time (min) (n=1313)	173 ± 36	172±20	126±19	165±26	187±28	181±32
RVOT Conduit (n = 1206)		NA				
Homograft	1189 (98.6)		161 (92.5)	292 (100)	112 (100)	624 (99.4)
Pulmonary	1185 (99.7)		161 (100)	289 (99.0)	112 (100)	623 (99.8)
Aortic	4 (0.3)		0 (0)	3 (1.0)	0 (0)	1 (0.2)
Bioprosthesis	17 (1.4)		13 (7.5)	0 (0)	0 (0)	4 (0.6)
In hospital mortality	10 (0.7%)	0 (0)	4 (2.3)	1 (0.3)	2 (1.8)	3 (0.5)

Abbreviations: CABG, coronary artery bypass grafting; CPB, cardio-pulmonary bypass; NYHA, New York Heart Association

Table e2. Risk factor analysis by penalized Cox regression: All-cause mortality

Factor	HR	95% CI	P-value
Age at operation (years)	1.06	(1.05; 1.08)	0.00
Sex (female)	1.42	(1.01; 2.01)	0.05
Weight at operation (kg)	1.01	(0.99; 1.04)	0.32
Previous cardiac surgery	1.86	(0.74; 4.70)	0.19
NYHA classification	1.39	(1.02; 1.89)	0.04
Tricuspid aortic valve	0.88	(0.35; 2.19)	0.78
Rheumatic heart disease	0.92	(0.25; 3.43)	0.90
Prosthetic valve in aortic position	0.15	(0.02; 1.24)	0.08
Degenerative valve disease	1.08	(0.75; 1.54)	0.69
Active aortic valve endocarditis	0.82	(0.17; 4.03)	0.81
Resolved aortic valve endocarditis	0.28	(0.05; 1.65)	0.16
Hypertension	0.91	(0.70; 1.18)	0.48
Coronary artery disease	1.51	(0.80; 2.82)	0.20
Peripheral artery disease	9.42	(3.92; 22.63)	0.00
Dyslipidemia	0.97	(0.58; 1.63)	0.92
Chronic obstructive pulmonary disease	5.06	(2.59; 9.88)	0.00
Congenital heart disease	1.92	(1.16; 3.20)	0.01
Peak aortic valve gradient (mmHg)	1.00	(0.97; 1.03)	0.99
Mean aortic valve gradient (mmHg)	0.98	(0.93; 1.03)	0.46
Aortic valve regurgitation - trace	0.63	(0.12; 3.34)	0.59
Aortic valve regurgitation – mild	0.71	(0.29; 1.76)	0.46
Aortic valve regurgitation – moderate	0.77	(0.26; 2.24)	0.63
Aortic valve regurgitation – severe	0.69	(0.15; 3.19)	0.64
Root replacement technique*	0.56	(0.21; 0.56)	0.26
Subcoronary implantation technique*	1.16	(0.75; 1.79)	0.51
Homograft (instead of biosprosthesis)	1.30	(0.50; 3.40)	0.59
Age of homograft donor (years)	1.00	(0.98; 1.02)	0.91
Sex of homograft donor (female)	0.84	(0.53; 1.33)	0.49
Homograft diameter (mm)	0.97	(0.88; 1.08)	0.61
Homograft cryopreservation	0.64	(0.26; 1.61)	0.35

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e3. Risk factor analysis by penalized Cox regression: Cardiac mortality

Factor	HR	95% CI	P-value
Age at operation (years)	1.05	(1.02; 1.01)	<0.01
Sex (female)	2.00	(1.34; 3.01)	<0.01
Weight at operation (kg)	1.02	(0.99; 1.05)	0.16
Previous cardiac surgery	2.50	(1.31; 4.75)	0.01
NYHA classification	1.37	(0.69; 2.72)	0.36
Tricuspid aortic valve	1.53	(0.48; 4.94)	0.48
Rheumatic heart disease	0.02	(0.01; 0.09)	<0.01
Prosthetic valve in aortic position	0.01	(0.00; 0.11)	<0.01
Degenerative valve disease	0.96	(0.35; 2.62)	0.94
Active aortic valve endocarditis	2.36	(0.51; 10.99)	0.27
Resolved aortic valve endocarditis	0.74	(0.10; 5.49)	0.77
Hypertension	0.57	(0.39; 0.82)	<0.01
Coronary artery disease	2.20	(1.36; 3.57)	<0.01
Peripheral artery disease	0.13	(0.03; 0.67)	0.01
Dyslipidemia	1.26	(0.62; 2.55)	0.52
Chronic obstructive pulmonary disease	8.15	(1.61; 41.14)	0.01
Congenital heart disease	10.06	(5.14; 19.71)	<0.01
Peak aortic valve gradient (mmHg)	1.017	(0.96; 1.08)	0.60
Mean aortic valve gradient (mmHg)	0.95	(0.86; 1.057)	0.36
Aortic valve regurgitation - trace	1.76	(0.24; 12.76)	0.58
Aortic valve regurgitation – mild	0.79	(0.12; 5.25)	0.81
Aortic valve regurgitation – moderate	0.69	(0.08; 6.04)	0.74
Aortic valve regurgitation – severe	1.66	(0.13; 21.73)	0.70
Root replacement technique*	0.49	(0.22; 1.079)	0.08
Subcoronary implantation technique*	0.98	(0.43; 2.24)	0.96
Homograft (instead of biosprosthesis)	11.26	(2.30; 55.18)	<0.01
Age of homograft donor (years)	1.03	(0.97; 1.102)	0.29
Sex of homograft donor (female)	0.95	(0.45; 1.98)	0.89
Homograft diameter (mm)	0.90	(0.75; 1.08)	0.27
Homograft cryopreservation	5.34	(0.55; 51.51)	0.15

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e4. Risk factor analysis by penalized Cox regression: Freedom from any reintervention

Factor	HR	95% CI	P-value
Age at operation (years)	1.01	(0.99; 1.03)	0.33
Sex (female)	0.62	(0.48; 0.79)	<0.01
Weight at operation (kg)	1.00	(0.99; 1.01)	0.37
Previous cardiac surgery	1.09	(0.48; 2.48)	0.85
NYHA classification	1.02	(0.78; 1.35)	0.86
Tricuspid aortic valve	0.93	(0.51; 1.67)	0.80
Rheumatic heart disease	0.06	(0.00; 1.79)	0.11
Prosthetic valve in aortic position	0.02	(0.00; 0.38)	0.01
Degenerative valve disease	1.01	(0.35; 2.90)	0.99
Active aortic valve endocarditis	0.49	(0.05; 4.53)	0.53
Resolved aortic valve endocarditis	0.21	(0.02; 1.89)	0.16
Hypertension	1.10	(0.56; 2.12)	0.79
Coronary artery disease	1.21	(0.85; 1.71)	0.29
Peripheral artery disease	0.03	(0.00; 0.17)	0.000
Dyslipidemia	0.73	(0.38; 1.39)	0.34
Chronic obstructive pulmonary disease	0.03	(0.01; 0.18)	<0.01
Congenital heart disease	3.61	(2.37; 5.80)	<0.01
Peak aortic valve gradient (mmHg)	1.00	(0.96; 1.05)	0.88
Mean aortic valve gradient (mmHg)	0.99	(0.92; 1.06)	0.68
Aortic valve regurgitation - trace	1.14	(0.66; 1.95)	0.65
Aortic valve regurgitation – mild	1.19	(0.58; 2.45)	0.63
Aortic valve regurgitation – moderate	1.76	(0.92; 3.39)	0.09
Aortic valve regurgitation – severe	3.08	(1.26; 7.52)	0.01
Root replacement technique*	0.97	(0.51; 1.82)	0.92
Subcoronary implantation technique*	0.81	(0.46; 1.42)	0.46
Homograft (instead of biosprosthesis)	1.40	(0.78; 2.48)	0.26
Age of homograft donor (years)	0.99	(0.97; 1.02)	0.60
Sex of homograft donor (female)	0.72	(0.39; 1.32)	0.29
Homograft diameter (mm)	0.90	(0.74; 1.10)	0.31
Homograft cryopreservation	1.42	(0.64; 3.13)	0.38

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e5. Risk factor analysis by penalized Cox regression: Freedom from autograft reintervention

Factor	HR	95% CI	P-value
Age at operation (years)	1.01	(0.99; 1.04)	0.25
Sex (female)	0.66	(0.45; 0.98)	0.04
Weight at operation (kg)	1.00	(0.98; 1.01)	0.81
Previous cardiac surgery	1.23	(0.51; 2.90)	0.67
NYHA classification	0.67	(0.51; 0.87)	<0.01
Tricuspid aortic valve	1.25	(0.62; 2.50)	0.54
Rheumatic heart disease	0.06	(0.00; 1.50)	0.09
Prosthetic valve in aortic position	0.02	(0.00; 0.44)	0.01
Degenerative valve disease	1.10	(0.30; 4.02)	0.89
Active aortic valve endocarditis	0.67	(0.09; 5.00)	0.70
Resolved aortic valve endocarditis	0.13	(0.02; 1.13)	0.07
Hypertension	1.09	(0.52; 2.30)	0.82
Coronary artery disease	1.27	(0.74; 2.18)	0.38
Peripheral artery disease	0.03	(0.00; 0.27)	<0.01
Dyslipidemia	0.44	(0.29; 0.66)	<0.01
Chronic obstructive pulmonary disease	0.05	(0.01; 0.35)	<0.01
Congenital heart disease	5.19	(2.93; 9.18)	<0.01
Peak aortic valve gradient (mmHg)	1.01	(0.96; 1.06)	0.78
Mean aortic valve gradient (mmHg)	0.97	(0.90; 1.05)	0.41
Aortic valve regurgitation - trace	1.12	(0.58; 2.18)	0.74
Aortic valve regurgitation – mild	1.34	(0.60; 3.00)	0.48
Aortic valve regurgitation – moderate	1.44	(0.59; 3.56)	0.43
Aortic valve regurgitation – severe	3.06	(1.02; 9.22)	0.05
Root replacement technique*	0.66	(0.36; 1.20)	0.17
Subcoronary implantation technique*	0.44	(0.25; 0.77)	<0.01
Homograft (instead of biosprosthesis)	1.28	(0.65; 2.43)	0.50
Age of homograft donor (years)	1.00	(0.97; 1.03)	0.91
Sex of homograft donor (female)	0.79	(0.38; 1.66)	0.53
Homograft diameter (mm)	0.92	(0.77; 1.04)	0.17
Homograft cryopreservation	1.40	(0.66; 2.96)	0.39

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e6. Risk factor analysis by penalized Cox regression: Freedom from homograft reintervention

Factor	HR	95% CI	P-value
Age at operation (years)	0.99	(0.97; 1.00)	0.05
Sex (female)	0.43	(0.19; 0.95)	0.04
Weight at operation (kg)	0.99	(0.97; 1.02)	0.68
Previous cardiac surgery	1.06	(0.53; 2.11)	0.87
NYHA classification	2.08	(1.66; 2.60)	<0.01
Tricuspid aortic valve	0.57	(0.14; 2.39)	0.44
Rheumatic heart disease	0.04	(0.01; 0.14)	<0.01
Prosthetic valve in aortic position	0.12	(0.030; 0.47)	<0.01
Degenerative valve disease	0.68	(0.49; 0.95)	0.02
Active aortic valve endocarditis	0.65	(0.31; 1.35)	0.25
Resolved aortic valve endocarditis	0.82	(0.40; 1.70)	0.60
Hypertension	1.43	(0.96; 2.15)	0.08
Coronary artery disease	0.90	(0.60; 1.36)	0.63
Peripheral artery disease	0.08	(0.01; 0.62)	0.02
Dyslipidemia	1.49	(0.94; 2.35)	0.09
Chronic obstructive pulmonary disease	0.07	(0.01; 0.53)	0.01
Congenital heart disease	1.35	(0.38; 4.80)	0.65
Peak aortic valve gradient (mmHg)	1.00	(0.97; 1.02)	0.77
Mean aortic valve gradient (mmHg)	1.01	(0.96; 1.05)	0.77
Aortic valve regurgitation - trace	1.42	(0.81; 2.51)	0.22
Aortic valve regurgitation – mild	0.69	(0.36; 1.33)	0.27
Aortic valve regurgitation – moderate	1.15	(0.58; 2.26)	0.69
Aortic valve regurgitation – severe	1.30	(0.28; 6.12)	0.74
Root replacement technique*	1.45	(0.33; 6.29)	0.62
Subcoronary implantation technique*	4.17	(1.73; 10.05)	<0.01
Homograft (instead of biosprosthesis)	18.14	(4.07; 80.76)	<0.01
Age of homograft donor (years)	0.97	(0.94; 0.99)	0.01
Sex of homograft donor (female)	0.50	(0.22; 1.13)	0.10
Homograft diameter (mm)	0.77	(0.66; 0.90)	<0.01
Homograft cryopreservation	1.55	(0.19; 12.74)	0.69

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e7. Model Coefficients for peak autograft gradient

Factor	Peak aortic gradient		
	Coefficient	95% CI	P-value
Age at operation (years)	-0.03	(-0.07; 0.00)	0.05
Sex (female)	0.77	(0.06; 1.48)	0.03
Weight at operation (kg)	0.02	(0.00; 0.04)	0.05
Previous cardiac surgery	0.43	(-0.93; 1.80)	0.53
NYHA classification	-0.35	(-1.08; 0.38)	0.35
Tricuspid aortic valve	2.22	(0.52; 3.91)	0.01
Rheumatic heart disease	-0.49	(-3.65; 2.66)	0.76
Prosthetic valve in aortic position	-0.830	(-4.19; 2.53)	0.63
Degenerative valve disease	-0.06	(-0.84; 0.72)	0.88
Active aortic valve endocarditis	1.63	(-6.75; 10.00)	0.70
Resolved aortic valve endocarditis	2.48	(-5.57; 10.52)	0.55
Hypertension	0.71	(0.06; 1.36)	0.03
Coronary artery disease	-1.11	(-2.43; 0.21)	0.10
Peripheral artery disease	1.89	(-2.96; 6.74)	0.44
Dyslipidemia	0.15	(-0.57; 0.87)	0.68
Chronic obstructive pulmonary disease	-0.07	(-1.97; 1.83)	0.94
Congestive heart failure	3.02	(-0.57; 6.62)	0.10
Peak aortic valve gradient (mmHg)	0.08	(0.03; 0.12)	<0.01
Mean aortic valve gradient (mmHg)	-0.11	(-0.18; -0.03)	0.01
Aortic valve regurgitation - trace	-0.13	(-1.28; 1.01)	0.82
Aortic valve regurgitation – mild	-0.44	(-1.64; 0.76)	0.47
Aortic valve regurgitation – moderate	-0.64	(-1.90; 0.62)	0.32
Aortic valve regurgitation – severe	0.05	(-1.80; 1.91)	0.95
Timing (elective)	-1.23	(-4.16; 1.71)	0.41
Root replacement technique*	1.27	(-2.23; 4.77)	0.48
Subcoronary technique*	1.61	(-0.88; 4.10)	0.20
Homograft (instead of biosprosthesis)	-3.5	(-6.05; -1.12)	<0.01

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e8. Odds Ratios, 95% CI's and Univariate Wald tests of covariates with autograft regurgitation

Factor	Autograft Regurgitation		
	Odds ratio	95% CI	P-value
Time (years)	1.13	(1.11; 1.16)	<.001
Age at operation (years)	1.06	(1.00; 1.05)	0.06
Sex (female)	0.81	(0.45; 1.44)	0.47
Weight at operation (kg)	0.98	(0.97; 1.00)	0.07
Previous cardiac surgery	0.62	(0.22; 1.78)	0.37
NYHA classification	0.47	(0.26; 0.83)	0.01
Tricuspid aortic valve	0.63	(0.18; 2.25)	0.48
No bicuspid or tricuspid aortic valve	0.75	(0.20; 2.79)	0.67
Congenital heart disease	0.58	(0.19; 1.83)	0.36
Degenerative valve disease	1.96	(1.04; 3.67)	0.04
Endocarditis	0.37	(0.16; 0.86)	0.02
Hypertension	0.88	(0.52; 1.49)	0.63
Mean aortic valve gradient (mmHg)	1.00	(0.98; 1.01)	0.79
Aortic valve regurgitation - trace	1.50	(0.60; 3.74)	0.38
Aortic valve regurgitation – mild	2.26	(0.87; 5.86)	0.09
Aortic valve regurgitation – moderate	2.72	(0.97; 7.64)	0.06
Aortic valve regurgitation – severe	2.11	(0.56; 8.03)	0.27
Dyslipidemia	0.69	(0.38; 1.25)	0.22
Timing (elective)	1.35	(0.22; 8.23)	0.74
Root replacement technique*	1.12	(0.26; 4.55)	0.88
Subcoronary technique*	0.21	(0.03; 1.46)	0.11
Homograft (instead of bioprosthesis)	0.12	(0.02; 0.90)	0.04
Age of homograft donor (years)	1.00	(0.98; 1.02)	0.85

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e9. Model Coefficients for peak homograft gradient

Factor	Peak pulmonary gradient		
	Coefficient	95% CI	P-value
Age at operation (years)	-1.95	(-3.64; -0.25)	0.02
Sex (female)	0.07	(0.02; 0.13)	<0.01
Weight at operation (kg)	-0.13	(-3.18; 2.93)	0.94
Previous cardiac surgery	-1.14	(-2.77; 0.49)	0.17
NYHA classification	-1.99	(-5.61; 1.63)	0.28
Tricuspid aortic valve	-4.27	(-7.88; -0.65)	0.02
Rheumatic heart disease	1.94	(-5.78; 9.67)	0.62
Prosthetic valve in aortic position	-0.61	(-2.35; 1.13)	0.49
Degenerative valve disease	-1.20	(-17.91; 15.52)	0.89
Active aortic valve endocarditis	2.89	(-13.96; 19.75)	0.74
Resolved aortic valve endocarditis	21.64	(10.35; 32.93)	<.01
Hypertension	-0.53	(-3.41; 2.35)	0.72
Coronary artery disease	-1.15	(-10.31; 8.02)	0.81
Peripheral artery disease	3.88	(0.79; 6.98)	0.01
Dyslipidemia	-1.89	(-5.92; 2.17)	0.37
Chronic obstructive pulmonary disease	10.95	(6.60; 15.30)	<.01
Congestive heart failure	-0.01	(-0.11; 0.08)	0.80
Peak aortic valve gradient (mmHg)	0.07	(-0.08; 0.22)	0.39
Mean aortic valve gradient (mmHg)	-1.02	(-3.36; 1.32)	0.39
Aortic valve regurgitation - trace	-0.12	(-2.61; 2.37)	0.92
Aortic valve regurgitation – mild	-0.66	(-3.34; 2.02)	0.63
Aortic valve regurgitation – moderate	1.80	(-1.74; 5.33)	0.32
Aortic valve regurgitation – severe	-1.14	(-6.21; 3.90)	0.66
Timing (elective)	-1.45	(-5.07; 2.17)	0.43
Root replacement technique*	1.60	(-3.84; 7.05)	0.56
Subcoronary technique*	-5.11	(-12.91; 2.69)	0.20
Homograft (instead of biosprosthesis)	-2.04	(-19.37; 15.28)	0.87

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Table e10. Odds Ratios, 95% CI's and Univariate Wald tests of covariates with homograft regurgitation

Factor	Homograft Regurgitation		
	Odds ratio	95% CI	P-value
Time (years)	1.16	(1.13; 1.19)	<.01
Age at operation (years)	0.99	(0.97; 1.02)	0.51
Sex (female)	2.63	(1.60; 4.32)	<0.01
Weight (kg)	1.01	(0.99; 1.02)	0.28
Previous cardiac surgery	1.52	(0.62; 3.76)	0.36
NYHA classification	0.78	(0.48; 1.28)	0.33
Tricuspid aortic valve	0.92	(0.31; 2.70)	0.87
No bicuspid or tricuspid aortic valve	1.11	(0.37; 3.38)	0.85
Congenital heart disease	1.04	(0.39; 2.77)	0.94
Degenerative valve disease	2.08	(1.21; 3.56)	0.01
Endocarditis	0.96	(0.48; 1.94)	0.91
Hypertension	0.76	(0.49; 1.20)	0.24
Mean aortic valve gradient (mmHg)	0.99	(0.98; 1.00)	0.13
Aortic valve regurgitation - trace	0.92	(0.42; 2.02)	0.84
Aortic valve regurgitation – mild	1.23	(0.54; 2.80)	0.62
Aortic valve regurgitation – moderate	0.83	(0.34; 2.01)	0.68
Aortic valve regurgitation – severe	1.12	(0.36; 3.52)	0.84
Dyslipidemia	1.85	(1.11; 3.07)	0.02
Timing (elective)	0.65	(0.13; 3.22)	0.60
Root replacement technique*	1.73	(0.46; 6.47)	0.42
Subcoronary technique*	1.28	(0.23; 7.07)	0.77
Homograft (instead of bioprosthesis)	0.05	(0.01; 0.29)	<0.01
Age of homograft donor (years)	0.97	(0.95; 0.99)	<0.01

Abbreviation: NYHA, New York Heart Association

* as compared with the root-inclusion technique

Supplemental Figures

Figure e1. Kaplan-Meier plots of overall reintervention per country.

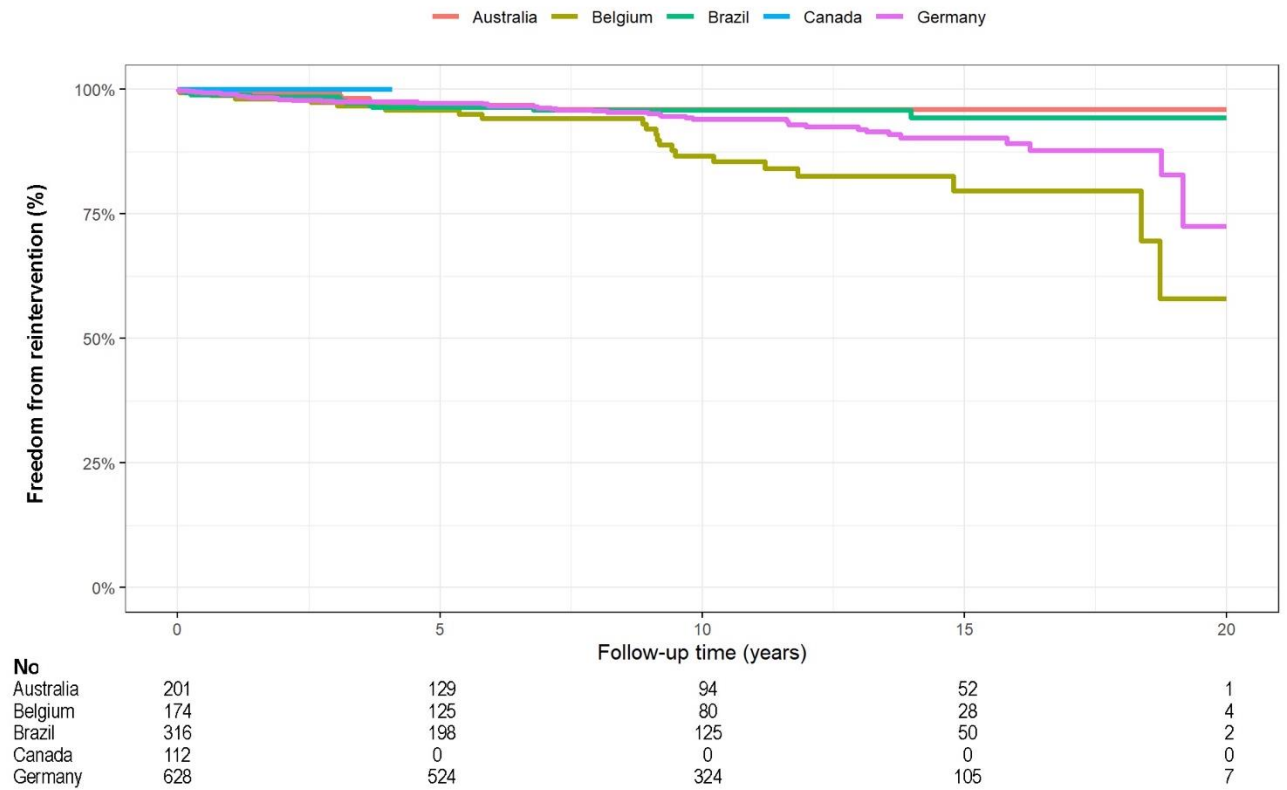


Figure e2. Kaplan-Meier plots of autograft reintegration per country.

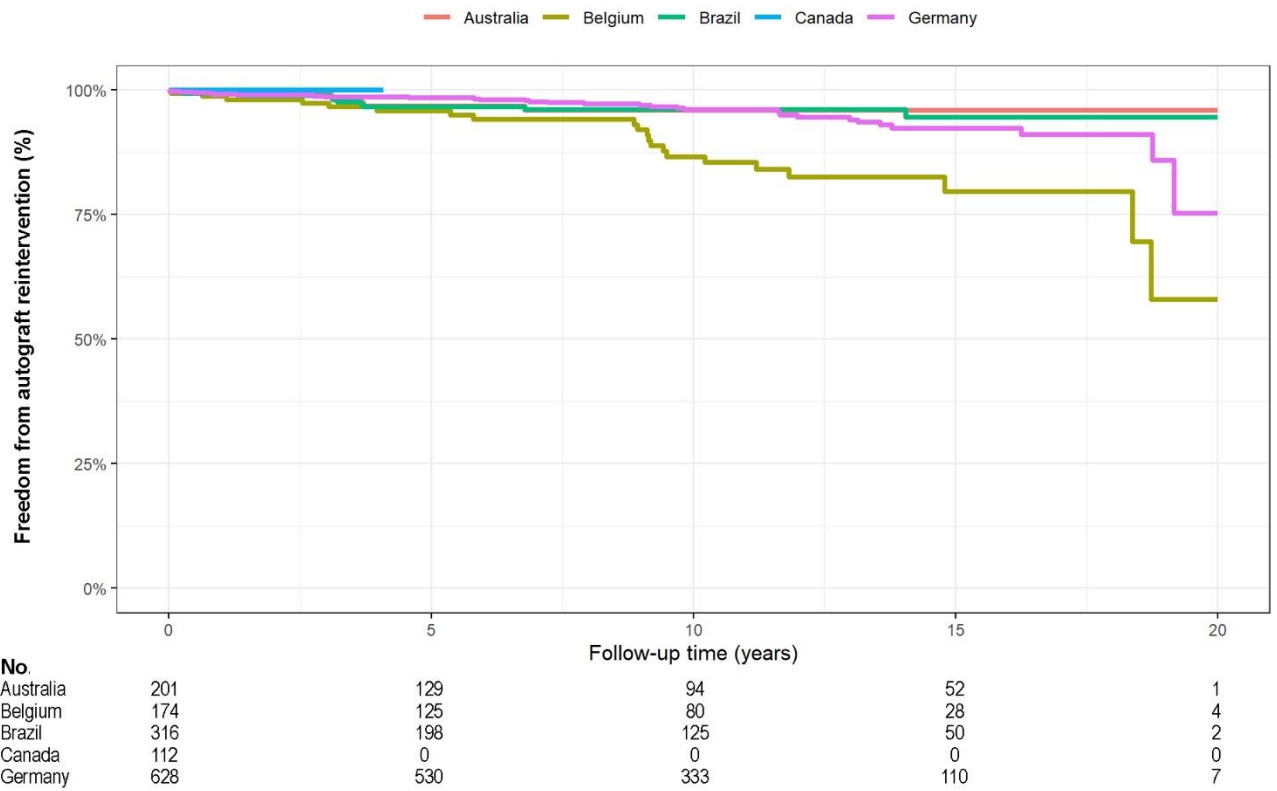


Figure e3. Kaplan-Meier plots of homograft reintervention per country.

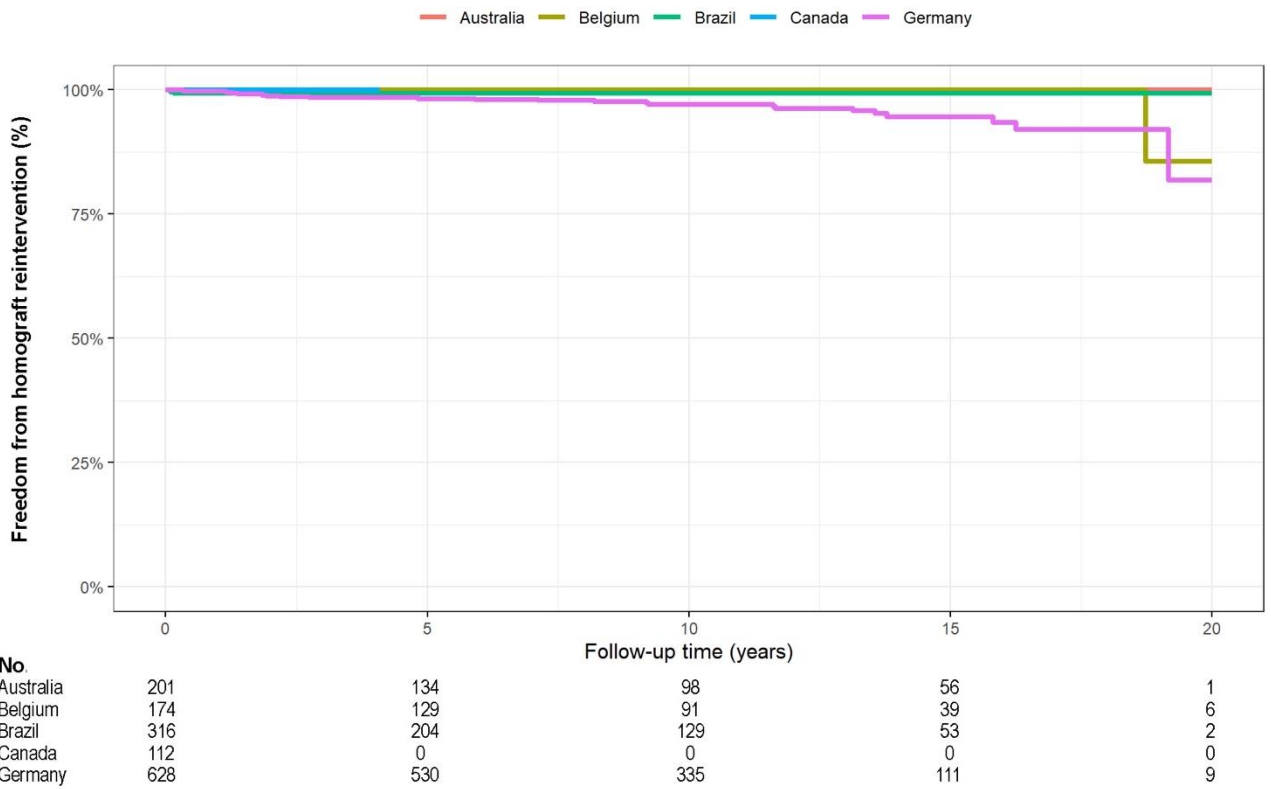


Figure e4. Effect plots of Autograft gradient and homograft gradient. Longitudinal evolution of the autograft peak gradient and homograft peak gradient in years after the Ross operation with 95% confidence interval as shaded area.

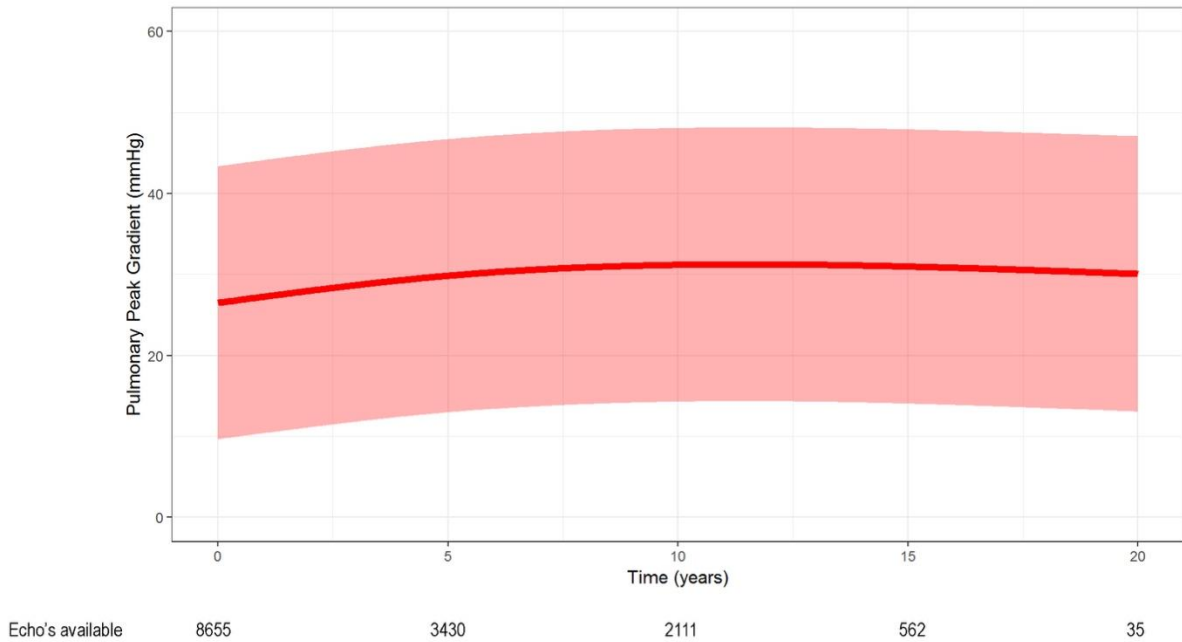
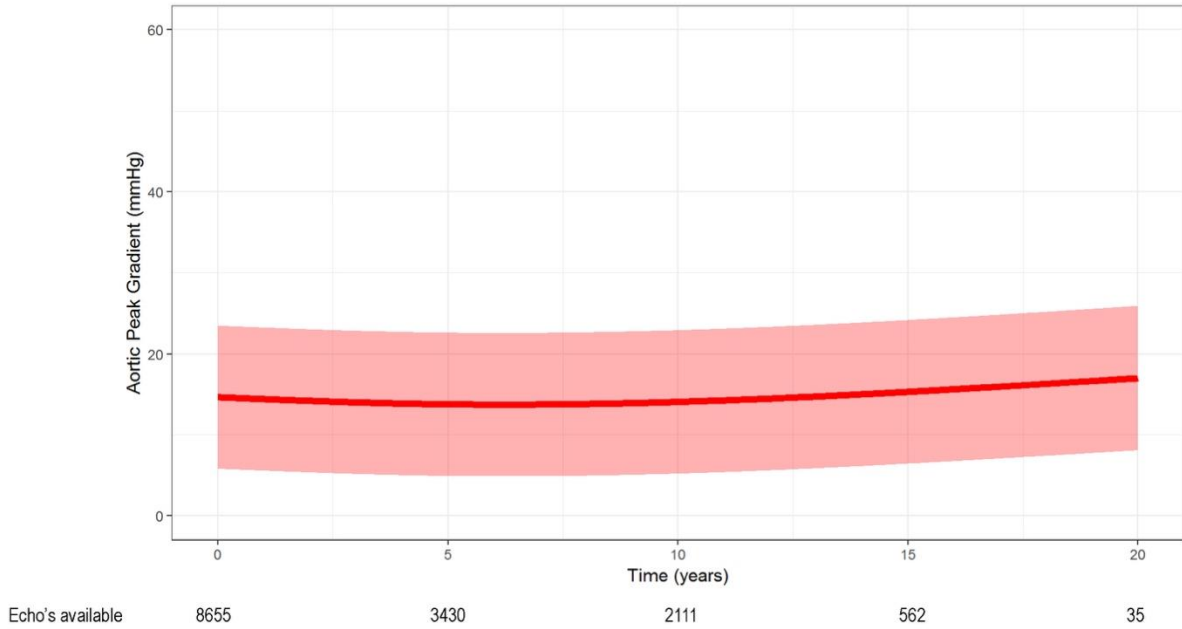
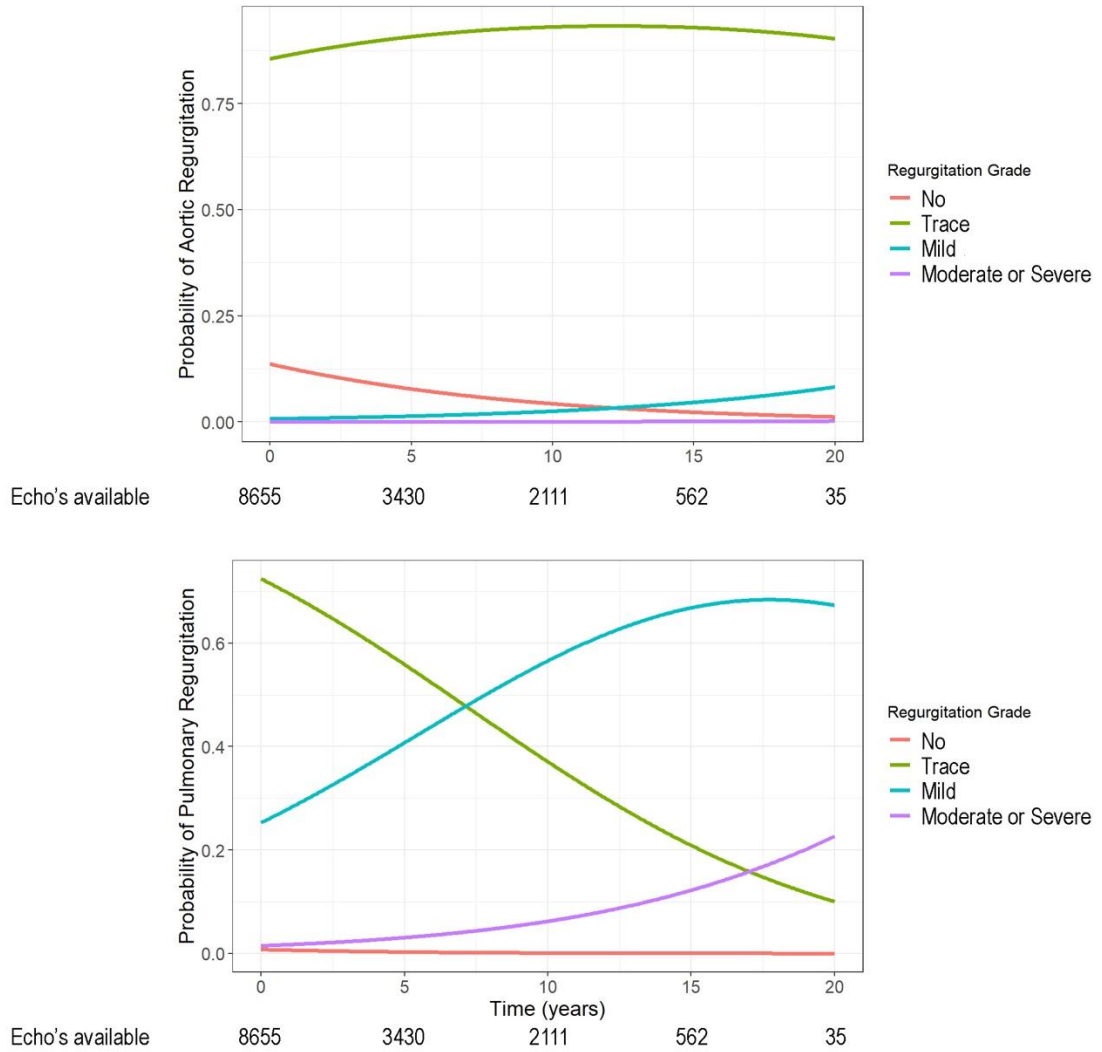


Figure e5. Effect plot of Autograft regurgitation and homograft regurgitation. Longitudinal evolution of the probability of each regurgitation grade of the autograft and homograft over time in a patient with median characteristics.



Appendix 1

List of participating centers

- Department of Cardiac Surgery, Santa Casa de Curitiba, Pontifícia Universidade Católica do Paraná, Curitiba, Paraná, Brazil
- Department of Cardiac and Thoracic Vascular Surgery, University of Lübeck, Lübeck, Germany
- Department of Cardiovascular Surgery, CHU Sainte Justine, Montreal, Canada, Montreal, QC, Canada
- Department of Cardiothoracic Surgery, Royal Melbourne Hospital, Melbourne, Victoria, Australia
- Department of Cardiovascular and Thoracic Surgery, Saint Luc University Clinic, Brussels, Belgium

Appendix 2

In depth description of the statistical analysis

Mixed-effects models for the Aortic Peak Gradient and the Pulmonary Peak Gradient

To analyze the repeated measurements of the aortic peak gradient and the pulmonary peak gradient, we used mixed-effects models. This type of models is appropriate for the analysis of repeated measurements over time as the within and between subject correlations are appropriately accounted for. To allow for non-linear subject-specific trajectories over time we used natural cubic splines with 1 knot placed at the median follow-up time, both for the fixed-effects and the random-effects structure of the models. Model assumptions were assessed using visual tools for the inspection of the residuals.

Mixed-effects models for the Aortic and Pulmonary Regurgitation Grades

To analyze the repeated measurements of the aortic and pulmonary regurgitation grades, we used continuation-ratio mixed-effects models. This type of models is appropriate for the analysis of ordinal outcomes over time. We assumed a linear evolution for the log-odds of regurgitation grade increase/decrease and we used a random-intercepts only model.

Penalized Likelihood Multivariable Cox Regression

For the analysis of the clinical endpoints we used multivariable Cox regression models. A penalized likelihood approach was used to account for the fact that the number of observed events was low relative to the numbers of candidate predictors considered. The ridge penalty was used for the penalization of the likelihood. The penalty parameter was selected using 10-fold cross-validation. The lambda with the lowest cross-validation error was then used. Multiple imputation (100 imputations) was used to account for missing covariate data and the results were subsequently pooled.