

Supplementary Materials

Left ventricular trabeculation in *Hominidae*: divergence of the human cardiac phenotype.

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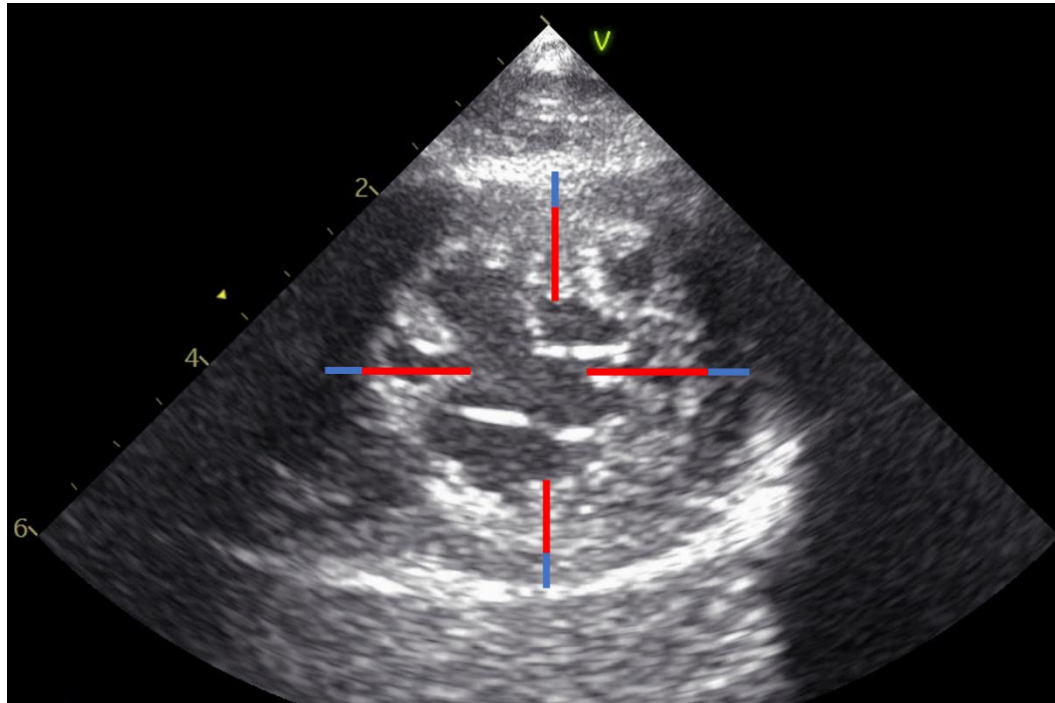
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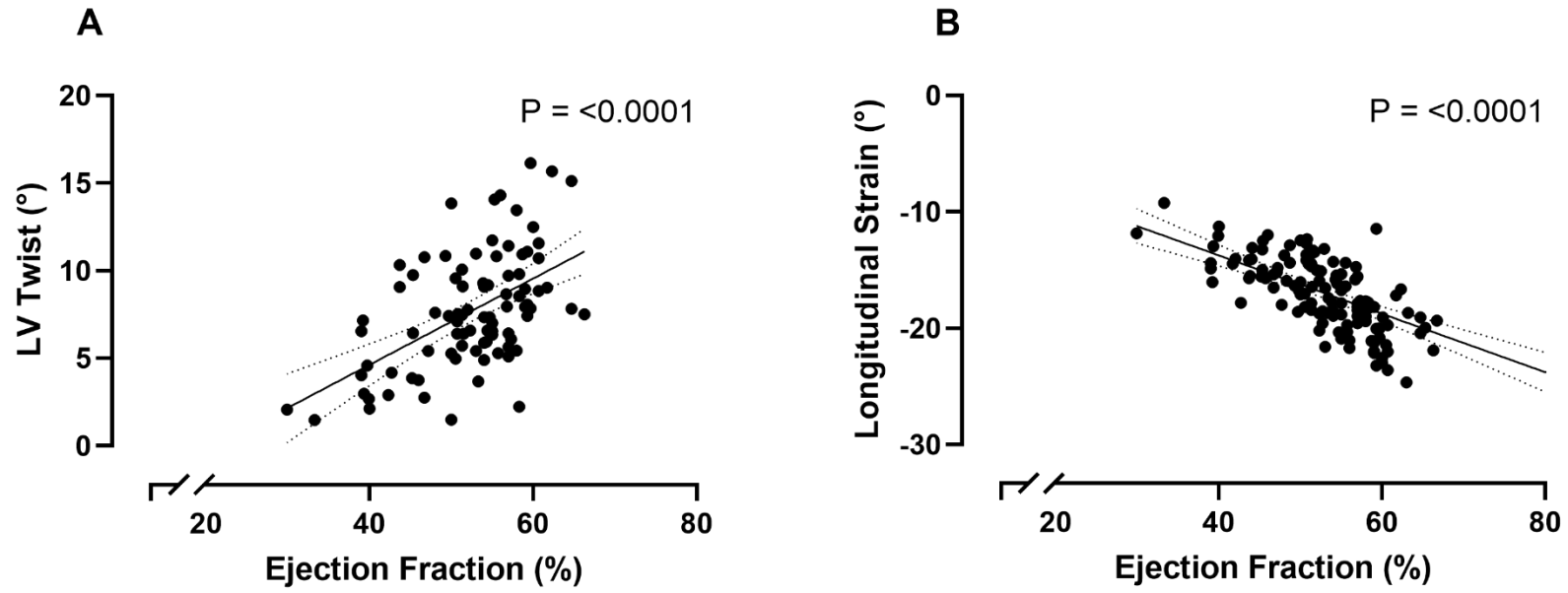
Supplementary Tables 1 to 3



Supplementary Figure 1. Example image showing a transverse slice at the mid-level of the left ventricle in an adult chimpanzee (*Pan troglodytes*) post-mortem heart, demonstrating a high degree of trabeculation. A ruler is shown for scale, with measurements in both inches (left) and centimetres (right).



Supplementary Figure 2. A 2D echocardiographic example of a parasternal short-axis image acquired at the left ventricular apex, illustrating the measurement of the trabecular (red) and compact (blue) myocardium in a chimpanzee (*Pan troglodytes*).



Supplementary Figure 3. The relationship between ejection fraction and peak left ventricular (LV) twist (A) (male $n = 47$, female $n = 43$) and peak longitudinal strain (B) (male $n = 66$, female $n = 66$) in adult male chimpanzees (*Pan troglodytes*). Linear regression lines are shown in solid black, with 95% confidence bands represented by the dotted line.

Supplementary Table 1. Left ventricular ratio of trabecular to compact myocardium in great apes. Trabeculation was assessed in accordance with the Jenni Criteria at end-systole, using short-axis echocardiographic images of the LV, in accordance with the 16-segment model recommended by the American Society of Echocardiography.

Variable	Humans (n = 34)	Chimpanzees (n = 242)	Bonobos (n = 7)	Gorillas (n = 14)	Orangutans (n = 28)
Basal Segments					
Anterior	0.38 ± 0.11*	0.62 ± 0.35 [‡]	0.76 ± 0.36	0.92 ± 0.27	
Anterolateral	0.33 ± 0.09*	0.63 ± 0.42 [‡]	1.10 ± 0.38	0.97 ± 0.42	
Inferolateral	0.33 ± 0.13*	1.05 ± 0.64	1.34 ± 0.29	1.48 ± 1.07	
Inferior	0.50 ± 0.58*	0.77 ± 0.36	1.01 ± 0.29	1.00 ± 0.38	
Inferoseptal	0.36 ± 0.13*	0.61 ± 0.29	0.74 ± 0.25	0.69 ± 0.29	
Anteroseptal	0.32 ± 0.14*	0.63 ± 0.38	1.59 ± 1.20	1.39 ± 1.08	
Average	0.34 ± 0.10* (0.21 – 0.61)	0.67 ± 0.23 [‡] (0.27 – 1.51)	0.95 ± 0.32 (0.56 – 1.45)	0.95 ± 0.24 (0.53 – 1.28)	
Midpapillary Segments					
Anterior	0.46 ± 0.18*	0.88 ± 0.39 [‡]	1.14 ± 0.48	1.19 ± 0.32	
Anterolateral	0.46 ± 0.19*	0.75 ± 0.34 [‡]	1.05 ± 0.63	1.13 ± 0.20	
Inferolateral	0.47 ± 0.21*	1.18 ± 0.75	1.90 ± 1.51	1.28 ± 0.57	
Inferior	0.44 ± 0.14*	0.85 ± 0.39	1.29 ± 0.78	1.20 ± 0.57	
Inferoseptal	0.43 ± 0.15 [†]	0.64 ± 0.32	0.97 ± 0.42	0.69 ± 0.34	
Anteroseptal	0.34 ± 0.13*	0.93 ± 0.60	1.59 ± 0.80	1.25 ± 0.47	
Average	0.43 ± 0.13* (0.25 – 0.78)	0.83 ± 0.25 (0.38 – 1.76)	1.16 ± 0.30 (0.65 – 1.48)	0.90 ± 0.15 (0.59 – 1.24)	
Apical Segments					
Anterior	0.38 ± 0.12*	1.59 ± 0.68 [§]	1.70 ± 0.48	1.71 ± 0.67	2.05 ± 0.78
Lateral	0.40 ± 0.17*	1.56 ± 0.63 [‡]	1.60 ± 0.49	2.00 ± 0.41	1.99 ± 0.89
Inferior	0.43 ± 0.17*	1.78 ± 0.75	1.74 ± 0.69	1.99 ± 0.37	2.31 ± 0.94
Septal	0.45 ± 0.20*	1.20 ± 0.59 [‡]	1.64 ± 0.47	1.74 ± 0.60	1.55 ± 0.78
Average	0.42 ± 0.15* (0.23 – 0.82)	1.46 ± 0.42 ^{‡§} (0.63 – 2.61)	1.58 ± 0.35 (1.17 – 2.28)	1.85 ± 0.34 (1.22 – 2.45)	1.94 ± 0.62 (1.04 – 4.10)

Trabecular:compact ratio for each left ventricular segment.

Data are presented as mean \pm S.D. The range of the average ratio for the trabecular to compact myocardium for the levels of the mitral valve, midpapillary and apex is shown in brackets.

* $P < 0.05$ vs. all non-human great apes; $P < 0.05$ vs. chimpanzees and bonobos; ‡ $P < 0.05$ vs. gorillas; § $P < 0.05$ vs. orangutans.

Supplementary Table 2. Left ventricular ratio of trabecular to compact myocardium in chimpanzees (*Pan troglodytes*) across age groups. Trabeculation was assessed in accordance with the Jenni Criteria at end-systole, using short-axis echocardiographic images of the LV, in accordance with the 16-segment model recommended by the American Society of Echocardiography. Infant ≤ 4 years; juvenile 5 - 7 years; sub-adult 8 - 12 years; and adult > 12 years of age.

Variable	Infant		Juvenile		Sub-Adult		Adult	
	Male (n = 11)	Female (n = 7)	Male (n = 14)	Female (n = 12)	Male (n = 22)	Female (n = 21)	Male (n = 79)	Female (n = 76)
Basal Segments								
Anterior	0.60 ± 0.25	0.72 ± 0.19	0.54 ± 0.31	0.56 ± 0.32	0.57 ± 0.17	0.72 ± 0.65	0.58 ± 0.24	0.66 ± 0.40
Anterolateral	0.62 ± 0.28	0.49 ± 0.22	0.67 ± 0.42	0.54 ± 0.23	0.58 ± 0.36	0.56 ± 0.26	0.63 ± 0.34	0.70 ± 0.59
Inferolateral	0.88 ± 0.42	0.91 ± 0.30	0.94 ± 0.33	0.84 ± 0.37	0.99 ± 0.56	1.00 ± 0.48	0.97 ± 0.54	1.10 ± 0.62
Inferior	0.76 ± 0.33	0.71 ± 0.21	0.59 ± 0.23	0.72 ± 0.28	0.83 ± 0.32	0.74 ± 0.32	0.74 ± 0.35	0.82 ± 0.41
Inferoseptal	0.65 ± 0.22	0.52 ± 0.14	0.53 ± 0.13	0.51 ± 0.22	0.55 ± 0.23	0.55 ± 0.30	0.65 ± 0.32	0.62 ± 0.31
Anteroseptal	0.61 ± 0.29	0.91 ± 0.36	0.46 ± 0.17	0.53 ± 0.28	0.66 ± 0.41	0.47 ± 0.18	0.61 ± 0.38	0.70 ± 0.43
Average	0.65 ± 0.19	0.69 ± 0.11	0.55 ± 0.13	0.61 ± 0.20	0.65 ± 0.17	0.61 ± 0.18	0.67 ± 0.24	0.71 ± 0.24
Midpapillary Segments								
Anterior	0.86 ± 0.20	1.01 ± 0.48	0.86 ± 0.36	0.79 ± 0.43	0.82 ± 0.30	0.81 ± 0.45	0.89 ± 0.37	0.88 ± 0.41
Anterolateral	0.64 ± 0.20	0.96 ± 0.41	0.87 ± 0.38	0.75 ± 0.34	0.73 ± 0.32	0.70 ± 0.39	0.78 ± 0.35	0.74 ± 0.35
Inferolateral	0.92 ± 0.54	1.35 ± 0.61	1.10 ± 0.48	1.23 ± 0.85	1.31 ± 0.60	0.96 ± 0.47	1.16 ± 0.80	1.24 ± 0.88
Inferior	0.76 ± 0.32	0.79 ± 0.24	1.03 ± 0.54	0.77 ± 0.37	0.84 ± 0.33	0.85 ± 0.33	0.90 ± 0.42*	0.77 ± 0.31
Inferoseptal	0.70 ± 0.21	0.58 ± 0.16	0.69 ± 0.27	0.68 ± 0.33	0.59 ± 0.30	0.60 ± 0.35	0.59 ± 0.32	0.61 ± 0.25
Anteroseptal	1.11 ± 0.66	0.96 ± 0.54	0.85 ± 0.47	1.04 ± 0.56	0.75 ± 0.53	0.85 ± 0.56	0.97 ± 0.56	0.92 ± 0.70
Average	0.77 ± 0.19	0.90 ± 0.27	0.86 ± 0.24	0.90 ± 0.37	0.79 ± 0.21	0.76 ± 0.25	0.83 ± 0.24	0.80 ± 0.23
Apical Segments								
Anterior	1.63 ± 0.46	1.24 ± 0.27	1.57 ± 0.65	1.44 ± 0.79	1.80 ± 0.65	1.75 ± 0.75	1.67 ± 0.68*	1.38 ± 0.59
Lateral	1.43 ± 0.40	1.31 ± 0.32	1.58 ± 0.71	1.53 ± 0.69	1.68 ± 0.68	1.64 ± 0.68	1.65 ± 0.63*	1.49 ± 0.62
Inferior	1.82 ± 0.85	1.28 ± 0.30	1.72 ± 0.62	2.02 ± 0.83	1.92 ± 0.88	1.60 ± 0.78	1.95 ± 0.74*	1.63 ± 0.69
Septal	0.91 ± 0.42	1.11 ± 0.49	1.46 ± 0.56	1.65 ± 0.97 [†]	1.19 ± 0.61	0.95 ± 0.50	1.27 ± 0.61	1.11 ± 0.52
Average	1.40 ± 0.50	1.21 ± 0.17	1.55 ± 0.45	1.59 ± 0.61	1.57 ± 0.47	1.40 ± 0.49	1.56 ± 0.39*	1.33 ± 0.35

Trabecular:compact ratio for each left ventricular segment. Data are presented as mean ± S.D.

* $P < 0.05$; within-age group sex difference; [†] $P < 0.05$ vs. sub-adults.

Supplementary Table 3. Left ventricular rotation and deformation ('strain') comparison between adult humans and chimpanzees (*Pan troglodytes*).

Variable	Males		Females	
	Chimpanzees	Humans	Chimpanzees	Humans
	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
Twist Mechanics				
Peak twist (°)	47	18	43	16
	6.9 ± 3.1*† (5.9 – 7.8)	14.4 ± 2.7 (12.9 – 15.9)	8.5 ± 3.3* (7.5 – 9.5)	15.9 ± 4.0 (14.3 – 17.5)
Peak untwisting velocity (°sec ⁻¹)	47	18	43	16
	-57.1 ± 26.0* (-65.1 – -49.1)	-100.1 ± 17.3* (-113.0 – -87.2)	-61.4 ± 27.2* (-69.8 – -53.1)	-109.6 ± 25.9 (-122.6 – -96.6)
Peak basal rotation (°)	59	18	55	16
	-6.0 ± 2.1* (-6.6 – -5.5)	-4.9 ± 1.8 (-5.9 – -3.9)	-5.6 ± 2.0 (-6.2 – -5.1)	-5.2 ± 3.0 (-6.2 – -4.1)
Peak apical rotation (°)	59	18	51	16
	2.6 ± 1.6*† (2.0 – 3.4)	10.0 ± 3.6 (8.8 – 11.3)	4.9 ± 2.9* (4.1 – 5.6)	11.5 ± 3.3 (10.2 – 12.8)
Strain Mechanics				
Peak basal radial strain (%)	59	18	55	16
	28.0 ± 10.4* (25.0 – 31.1)	43.6 ± 11.3 (38.2 – 49.1)	31.9 ± 12.4* (28.8 – 35.0)	45.5 ± 14.2 (39.7 – 51.3)
Peak apical radial strain (%)	59	18	51	16
	8.7 ± 7.1* (6.2 – 11.3)	25.3 ± 14.5 (20.7 – 29.8)	7.6 ± 9.1* (5.0 – 10.3)	27.0 ± 14.1 (22.1 – 31.8)
Peak basal circumferential strain (%)	59	18	55	16
	-13.7 ± 3.3*† (-14.5 – -12.9)	-18.7 ± 2.7 (-20.1 – -17.2)	-16.3 ± 3.2* (-17.2 – -15.5)	-20.0 ± 2.4 (-21.5 – -18.4)
Peak apical circumferential strain (%)	59	18	51	16
	-19.0 ± 3.2*† (-20.0 – -18.1)	-24.2 ± 4.5† (-25.9 – -22.5)	-22.6 ± 3.6* (-23.6 – -21.6)	-29.2 ± 3.7 (-31.0 – -27.4)
Peak longitudinal strain (%)	66	18	66	16
	-15.0 ± 2.2*† (-15.6 – -14.5)	-18.8 ± 1.9† (-19.9 – -17.8)	-19.0 ± 2.4* (-19.6 – -18.5)	-22.6 ± 1.7 (-23.7 – -21.5)

Data are presented as mean ± S.D. 95% CI shown in brackets.

**P* < 0.05; within-sex species difference; †*P* < 0.05; within-species sex difference.