

Table 1

Raw dimensions of the La Ferrassie 1 malleus, summary statistics of other fossils, recent and fossil modern human samples, and results of the z-score analysis between Neandertals and recent modern humans.^a

Specimen/Sample	Total length (mm)	Manubrium length (mm)	Manubrium ML thickness (mm)	Manubrium arc depth (mm)	Length of the corpus (mm)	S-I head width (mm)	Angle between the axes (°)	Source
La Ferrassie 1	8.78	4.90	1.10	0.49	6.26	2.60	140.6	This study
La Ferrassie 3		4.89	1.26*	0.44		<u>2.92**</u>		Quam et al., 2013b
Neandertals mean \pm s.d.	8.56 \pm 0.36							Stoessel et al., 2016a
Neandertals range (<i>n</i>)	8.23–8.96 (4)							
Mid. Pleist. Europe range (<i>n</i>)	8.80–8.98 (2)	5.16 (1)			6.40 (1)	2.70 (1)		Martínez et al., 2004; Crevecoeur, 2007; Stoessel et al., 2016a
Fossil <i>H. sapiens</i> mean \pm s.d.	7.84 \pm 0.23	4.49 \pm 0.27	0.95 \pm 0.13	0.24 \pm 0.09	5.42 \pm 0.18	2.45 \pm 0.12	137.4 \pm 3.2	Original specimens; Lisoněk and Trinkaus, 2006
Fossil <i>H. sapiens</i> range (<i>n</i>)	7.37–8.10 (8)	4.02–4.80 (6)	0.81–1.10 (4)	0.14–0.33 (4)	5.21–5.67 (7)	2.30–2.62 (7)	132.1–140.0 (5)	Crevecoeur, 2007; Ponce de León and Zollikofer, 2013
Recent <i>H. sapiens</i> mean \pm s.d.	8.25 \pm 0.41	4.94 \pm 0.31	1.00 \pm 0.09	0.33 \pm 0.15	5.83 \pm 0.35	2.43 \pm 0.17	132.1 \pm 6.2	Quam, 2006
Recent <i>H. sapiens</i> range (<i>n</i>)	7.43–9.31 (43)	4.22–5.59 (43)	0.81–1.28 (43)	0.05–0.64 (43)	4.96–6.69 (43)	2.03–2.79 (43)	116.5–145.7 (43)	

^a Values underlined are outside the range of the modern human comparative sample. The fossil remains with a * or ** are significantly different from the modern comparative sample based on a z-score analysis (* $p < 0.05$, ** $p < 0.01$). Values in bold indicate those values that are significantly different and/or outside of the range of the modern human sample.

Table 2

Raw dimensions of the La Ferrassie 1 incus, summary statistics of other fossils, recent and fossil modern human samples, and results of the z-score analysis between Neandertals and recent modern humans.^a

Specimen/Sample	Short process length (mm)	Long process length (mm)	Functional length (mm)	Long process arc depth (mm)	Articular facet height (mm)	Inter-process length (mm)	Inter-process arc depth (mm)	Angle between the axes (°)	Incudal index	Source
La Ferrassie 1	5.26	7.22	4.25	0.55	<u>3.50**</u>	5.71	1.81	53.7*	72.9	This study
La Ferrassie 3	4.74	6.89	4.08	0.40	3.34	<u>5.51*</u>	1.43	<u>48.2**</u>	68.8	Quam et al., 2013b
Amud 7	5.07	6.98	4.08	0.28**	<u>3.44*</u>	<u>5.38*</u>	<u>2.13*</u>	<u>48.3**</u>	72.6	Quam and Rak, 2008
Neandertal sample (mean ± s.d)		7.25 ± 0.28								Stoessel et al., 2016a
Neandertals range (n)		6.74–7.58 (10)								
Mid. Pleist. Europe range (n)	4.90 (1)	7.50–7.69 (2)	4.33 (1)			5.90 (1)				Martínez et al., 2004; Lisoněk and Trinkaus, 2006; Crevecoeur, 2007
Fossil <i>H. sapiens</i> (mean ± s.d)	4.76 ± 0.44	6.61 ± 0.29	3.90 ± 0.19	0.38 ± 0.10	3.23 ± 0.15	5.79 ± 0.44	1.58 ± 0.27	61.3 ± 4.9	71.3 ± 4.5	Lisoněk and Trinkaus, 2006; Crevecoeur, 2007; Quam et al., 2013b; Stoessel et al., 2016a
Fossil <i>H. sapiens</i> range (n)	4.10–5.50 (7)	6.30–7.10 (8)	3.57–4.11 (6)	0.26–0.56 (7)	2.99–3.45 (7)	5.29–6.60 (6)	1.30–2.00 (6)	52.4–67.3 (7)	64.1–77.5 (6)	
Recent <i>H. sapiens</i> (mean ± s.d)	5.07 ± 0.37	6.83 ± 0.32	4.00 ± 0.21	0.56 ± 0.14	3.00 ± 0.19	6.18 ± 0.34	1.66 ± 0.21	64.0 ± 4.7	74.3 ± 4.9	Quam, 2006
Recent <i>H. sapiens</i> range (n)	4.02–5.86 (41)	6.17–7.59 (43)	3.61–4.46 (42)	0.25–0.80 (43)	2.60–3.41 (42)	5.61–7.44 (41)	1.18–1.95 (41)	56.6–75.6 (41)	59.2–84.8 (41)	

^aValues underlined are outside the range of the modern human comparative sample. The fossil remains with a * or ** are significantly different from the modern comparative sample based on a z-score analysis (* $p < 0.05$, ** $p < 0.01$). Values in bold indicate those values that are significantly different and/or outside of the range of the modern human sample.

Table 3

The middle ear lever ratio^a in La Ferrassie 1 and Pleistocene and recent hominins.^a

Specimen/Sample	Malleus functional length (mm)	Incus functional length (mm)	Middle Ear lever ratio ^b	Source
Mid. Pleist. Europe (<i>n</i> = 1)	5.16	4.33	119.2	Martínez et al., 2004
La Ferrassie 1	4.90	4.25	115.3	This study
La Ferrassie 3	4.89	4.08	119.9	Quam et al., 2013b
Neandertals mean \pm s.d.			116.0 \pm 10.0	Stoessel et al., 2016a
Neandertals range (<i>n</i>)			105.0–125.0 (5)	
Qafzeh 12	<u>4.02**</u>	3.84	104.7*	Quam and Rak, 2008
Qafzeh 15	4.48	<u>3.57*</u>	125.5	Quam and Rak, 2008
Dolní Věstonice 14	4.60	4.11	111.9	Lisoněk and Trinkaus, 2006
Recent <i>H. sapiens</i> (mean \pm s.d)	4.94 \pm 0.31	4.00 \pm 0.21	123.4 \pm 8.5	Quam, 2006
Recent <i>H. sapiens</i> range (<i>n</i>)	4.22–5.59 (43)	3.61–4.46 (42)	101.9–138.9 (42)	
Recent <i>H. sapiens</i> (mean \pm s.d)			120.1 \pm 8.4	Stoessel et al., 2016a
Recent <i>H. sapiens</i> range (<i>n</i>)			107.7–137.0 (27)	

^aValues underlined are outside the range of the modern human comparative sample. The fossil remains with a * or ** are significantly different from the modern comparative sample based on a z-score analysis (**p* < 0.05, ***p* < 0.01). Values in bold indicate those values that are significantly different and/or outside of the range of the modern human sample.

^bLever ratio = (Malleus functional length/Incus functional length) \times 100

Table 4

Raw dimensions of the La Ferrassie 1 stapes, summary statistics of other fossils, recent and fossil modern human samples, and results of the z-score analysis between Neandertals and recent modern humans.^a

Specimen/Sample	Head	Total	Foramen	Obturatorfor amen width (mm)	Anterior crus length (mm)	Posterior crus length (mm)	Angle A (°)	Angle B (°)	Angle C (°)	Stapedial index	Source
La Ferrassie 1	1.05	3.04	1.65	1.98	2.56	3.29	52.1	78.3	49.6	90.1	This study
La Ferrassie 3	<u>0.71</u>**	2.76	1.89	1.79	2.38	3.20	47.3	86.9	45.7	90.6	Quam et al., 2013b
La Ferrassie 8	<u>0.80</u>*	2.63	1.75	1.74	2.60	3.20	48.3	89.7	42.0	83.3	Gómez-Olivencia et al., 2015
Subalyuk 2	0.93	(2.70)	(1.60)	1.60	(2.45)	(2.90)	(50.3)				Quam et al., 2013b
Neandertal sample (mean ± s.d)		3.11 ± 0.18									Stoessel et al., 2016a
Neandertal sample range (n)		2.88–3.31 (5)									
Oase 2					(3.2)	(3.0)					Ponce de León and Zollikofer, 2013
Cro-Magnon 1		3.39									Stoessel et al., 2016a
Recent <i>H. sapiens</i> (mean ± s.d.)	1.21 ± 0.16	3.44 ± 0.20	1.90 ± 0.18	1.74 ± 0.19	3.40 ± 0.21	3.35 ± 0.20	49.7 ± 3.4	67.4 ± 3.5	63.0 ± 4.1	85.90 ± 5.29	Quam, 2006
Recent <i>H. sapiens</i> range (n)	0.84–1.52 (40)	2.94–3.87 (40)	1.52–2.30 (41)	1.34–2.18 (42)	2.94–3.93 (40)	2.77–3.72 (40)	44.3–59.6 (40)	60.4–75.0 (40)	53.6–70.3 (40)	77.20–102.72 (39)	

^aValues in parentheses are estimated. Values underlined are outside the range of the modern human comparative sample. The fossil remains with a * or ** are significantly different from the modern comparative sample based on a z-score analysis (* = $p < 0.05$, ** = $p < 0.01$). Values in bold indicate those values that are significantly different and/or outside of the range of the modern human sample.

Table 5

Comparison of stapes footplate and oval window dimensions in the La Ferrassie 1 Neandertal compared to other Neandertals, Middle Pleistocene fossils, and recent and fossil modern humans.^a

Specimen/Sample	Footplate length (mm)	Footplate width (mm)	Measured footplate area (mm ²)	Measured oval window area (mm ²)	Footplate index	Oval window index	Source
La Ferrassie 1	2.74	1.49	3.39		54.4*		Original specimen
La Ferrassie 3	(2.50)**	(1.25)		2.70	(50.0)	54.0	Original specimen
La Ferrassie 8	<u>2.19**</u>	1.22	<u>2.16**</u>		55.7*		Gómez-Olivencia et al., 2015
Neandertals (mean ± s.d.)			2.58 ± 0.20	3.01 ± 0.35		54.6 ± 1.6	Quam et al., 2013b; Stoessel et al., 2016a
Neandertals range (<i>n</i>)			2.35–2.81 (5)	2.36–3.67 (18)		53.2–56.5 (5)	
Mid. Pleist. Europe range (<i>n</i>)			2.77 (1)	3.02–3.98 (3)			Martínez et al., 2004
Oase 2	2.9						Ponce de León and Zollikofer, 2013
Cro Magnon 1			2.99				Stoessel et al., 2016a
Fossil <i>H. sapiens</i> (mean ± s.d.)				3.46 ± 0.28		48.8 ± 5.8	Quam et al., 2013b
Fossil <i>H. sapiens</i> range (<i>n</i>)				3.06–3.88 (9)		36.7–55.8 (9)	
Recent <i>H. sapiens</i> (mean ± s.d.)	2.94 ± 0.14	1.39 ± 0.10	3.39 ± 0.32		47.29 ± 3.30		Original specimens
Recent <i>H. sapiens</i> range (<i>n</i>)	2.47–3.27 (46)	1.20–1.63 (43)	2.95–4.29 (41)		40.27–57.09 (43)		

^aValues in parentheses are estimated. Values underlined are outside the range of the modern human comparative sample. The fossil remains with a * or ** are significantly different from the modern comparative sample based on a z-score analysis (**p* < 0.05, ***p* < 0.01). Values in bold indicate those values that are significantly different and/or outside of the range of the modern human sample.

Table 6

Fracture properties in the La Ferrassie 1 long bones.

		NISP^a	%
Fracture outline	Longitudinal	0	0.0
	Transversal	16	80.0
	Oblique	4	20.0
Fracture angle	Right	11	100.0
	Acute/obtuse	0	0.0
	Mixed	0	0.0
Fracture edge	Smooth	0	0.0
	Jagged	17	100.0
	Mixed	0	0.0
Shaft circumference	1: < 50%	0	0.0
	2: > 50%	0	0.0
	3: Complete	18	100.0
Shaft fragment	1: <25%	0	0.0
	2: 25-50%	1	5.6
	3: 50-75%	3	16.7
	4: >75%	14	77.8

^aNISP = Number of identified specimens

Table 7

Results of the chi square analysis of the fracture properties of La Ferrassie 1 compared to other samples^a.

Long bones	Fracture angle	Fracture outline	Shaft circumference
LF1 vs Sarrians	n (11/269) Chi ² = 5.6943 p = 0.058	n (20/326) Chi ² = 5.0299 p = 0.081	n (18/226) Chi ² = 2.3178 p = 0.314
LF1 vs Fontbrégoua	n (11/174) Chi ² = 25.609 p = 2.75E-06	n (20/169) Chi ² = 6.36 p = 0.041586	n (18/151) Chi ² = 89.681 p = 3.36E-20
LF1 vs SH	n (11/471) Chi ² = 1.3907 p = 0.499	n (20/587) Chi ² = 1.4454 p = 0.485	n (18/475) Chi ² = 1.3839 p = 0.501
Cranial bones	Fracture angle	Cortical delamination	
LF1 vs SH	N (25/513) Chi ² = 0.88016 p = 0.348	N (25/518) Chi ² = 1.2648 p = 0.261	
LF1 vs Agris	N (25/15) Chi ² = 25.378 p = 4.71E-07	N (25/15) Chi ² = 35.897 p = 2.08E-09	
LF1 vs AUZAI	N (25/46) Chi ² = 40.888 p = 1.61E-10	N (25/46) Chi ² = 11.225 p = 0.00081	
LF1 vs Corconne	N (25/297) Chi ² = 1.3527 p = 0.245	N (25/297) Chi ² = 3.8446 p = 0.050	
LF1 vs Villedubert	N (25/1760) Chi ² = 1.6228 p = 0.203	N (25/1760) Chi ² = 3.5643 p = 0.059	
LF1 vs LC1	N (25/16) Chi ² = 3.7028 p = 0.054	N (26/17) Chi ² = 0.096099 p = 0.757	
LF1 vs LQH5	N (25/30) Chi ² = 0.056122 p = 0.813	N (26/31) Chi ² = 0.016073 p = 0.899	

^aBold p -values refer to significant results. Data for LF1 (La Ferrassie 1), LC1 (La Chapelle-aux-Saints 1), and LQH5 (La Quina H5) are original from this work. In the all other cases, it has been extracted from the bibliography: Sarrians and Fontbrégoua Neolithic assemblages from Villa and Mahieu (1991); Agris Mesolithic site, AUZAI (Châteliers du Vieil-Auzay from the Neolithic period), the Neolithic site of Corconne site and the Chalcolithic site of Villedubert from Jordana et al. (2013); and SH (Sima de los Huesos Middle Pleistocene hominins) from Sala et al. (2015a, 2016). Fontbrégoua, Agris and Châteliers du Vieil-Auzay are considered typically fresh bone fractured samples. Sarrians, Corconne,