nature
SUPPLEMENTARY INFORMATION
https://doi.org/10.1038/s41586-019-1067-9

In the format provided by the authors and unedited.

A new species of *Homo* from the Late Pleistocene of the Philippines

Florent Détroit[1]*, Armand Salvador Mijares[2,3]*, Julien Corny[1], Guillaume Daver[4], Clément Zanolli[5,6], Eusebio Dizon[3], Emil Robles[2], Rainer Grün[7,8] & Philip J. Piper[3,9]

[1]Département Homme & Environnement, Muséum National d'Histoire Naturelle, UMR 7194, CNRS, Musée de l'Homme, Paris, France. [2]Archaeological Studies Program, University of the Philippines, Quezon City, The Philippines. [3]National Museum of the Philippines, Manila, The Philippines. [4]Laboratoire Paléontologie Evolution Paléoécosystèmes Paléoprimatologie (PALEVOPRIM), UMR 7262, CNRS, Université de Poitiers, Poitiers, France. [5]Laboratoire PACEA, UMR 5199 CNRS, Université de Bordeaux, Bordeaux, France. [6]Laboratoire AMIS, UMR 5288 CNRS, Université Toulouse III Paul Sabatier, Toulouse, France. [7]Australian Research Centre for Human Evolution, Environmental Futures Research Institute, Griffith University, Brisbane, Queensland, Australia. [8]Research School of Earth Sciences, Australian National University, Canberra, Australian Capital Territory, Australia. [9]School of Archaeology and Anthropology, Australian National University, Canberra, Australian Capital Territory, Australia. *e-mail: florent.detroit@mnhn.fr; mandy24_us@yahoo.com

Supplementary Information

Detailed morphological descriptions of the new Callao Cave Hominin (CCH) fossils attributed to *Homo luzonensis, sp. nov.*

Postcanine maxillary teeth (CCH6-a to CCH6-e, CCH8, CCH9)

Of the seven posterior maxillary teeth discovered in layer 14, six are from the right side (CCH6-a to CCH6-e and CCH9) and one (CCH8) is from the left side (Figs. 2a, 2f, 2g; Extended Data Fig. 1 and Supplementary Table 1). The general state of preservation of CCH teeth is very good. The M^2 CCH6-b and the M^3 CCH9 are complete; the other teeth present a well-preserved crown, and at least one - sometimes all - partly broken roots. Micro-fissures are present in the enamel, dentine and cement, and the pulp cavity is generally filled by calcium carbonate, but those post-depositional modifications do not affect the size, shape or morphological attributes of the teeth. No maxilla fragment was found in the excavation and the teeth were not discovered in actual anatomical association. However, five of the upper right teeth (CCH6-a to CCH6-e: P^3 to M^3, in reverse order) were found within few decimetres of each other and belong to the same individual (CCH6) as shown by the perfect articulation of their interproximal contact facets (Extended Data Fig. 1d), as well as compatible wear stages of their respective occlusal surfaces. The exact determination of the left upper premolar CCH8 (P^3 or P^4) remains uncertain. While the three roots rather point to a P^3 (P^4 with three roots are extremely rare in fossil and recent hominins[1,2]), the morphology of the Enamel Dentine Junction (EDJ) tends to resemble more closely that of the right P^4 CCH6-d (Extended Data Figs 1, 4d-e). The CCH maxillary posterior teeth show a unique mosaic of archaic (mostly premolars) and derived (mostly molars) metrical and morphological features.

H. luzonensis upper premolars have asymmetrical crowns, with a large and mesially displaced lingual cusp. The enamel dentine junction (EDJ) of CCH premolars (CCH6-d, CCH6-e, CCH8) shows two main cusps, with the lingual one that is mesially displaced relative to the buccal one. On P^3s and P^4, the essential crests are not bifurcated and they are obliquely oriented, distally displaced. Mesial accessory ridges are present on all upper premolars, and they form an uninterrupted transverse ridge on the left $P^{3/4}$ CCH8. On all premolars, two small accessory tubercles are present on the buccal margin, located mesially and distally of the main buccal cusp respectively. On their buccal side, the premolars show one strongly developed vertical ridge that reaches the main buccal cusp and that is bordered mesially and distally by deep vertical grooves. The grooves separate the main vertical ridge from one mesial and one distal vertical ridges. Procrustes analyses of the EDJ of CCH premolars indicate that they clearly differ from those of *H. sapiens* (Fig. 4, Extended Data Figs 4d-e). The shape of the EDJ of CCH P^3 is intermediate between that of *H. neanderthalensis* and *H. floresiensis* (Fig. 4b, Extended Data Fig. 4d). The P^3 has 3 roots, with the two buccal roots bifurcating from each other only few millimetres away from the cemento-enamel junction. The P^4 has 2 roots. The specimen CCH8, whose attribution to a P^3 or P^4 is uncertain, exhibits a three-rooted morphology. From the best preserved premolar roots (right P^4 CCH6-d and left $P^{3/4}$ CCH8), it can be seen that they are robust with an almost constant circular section that narrows only at the apex, and they are highly divergent from each other. The mesial IPCF on the P^3 CCH6-e is small (compared to IPCFs present on the other teeth of CCH6), indicating that the upper canine was probably small (Extended Data Fig. 1d).

The morphology of the enamel and EDJ of the dental crowns of CCH upper molars is derived, *Homo sapiens*-like. The enamel occlusal morphology is very simple, with no crenulation of the enamel (/EDJ) and a reduced number of cusps. All upper molars have 4 cusps, with M^2 and M^3s having a reduced metacone and a very reduced hypocone. M^2 shows 4 dentine horns at the EDJ: 2 major horns corresponding to the protocone and paracone, and 2 minor horns corresponding to the metacone and hypocone. The pulp cavity of the same tooth has 2 major horns (protocone and paracone) and a very small horn corresponding to the metacone. The EDJ of M^1 and M^2 also shows a very simple morphology, with a well-marked oblique crest between the protocone and the metacone. No accessory cusplet or ridge is present on both teeth. However, the EDJ of M^2 shows a distinct bulging at the lingual face of the crown that corresponds to the expression of a Carabelli's cusp. Although the two right M^3s (CCH6-a and CCH9) have not been CT-scanned, they exhibit very similar external crown morphologies. In both M^3s, the hypocone is extremely reduced, resulting in a small crown with a particularly reduced mesio-distal diameter. Procrustes analyses of the EDJ of CCH molars indicate an intermediate signal between *H. neanderthalensis* and *H. erectus* for the M^2 CCH6-b, whereas the M^1 CCH6-c shows closer affinities to *H. erectus* (Extended Data Figs 4f-i). M^1 has two buccal roots and one lingual root, with three distinct pulp canals. The lingual and distobuccal roots are almost completely fused (the 2 apexes only separates on less than 2 mm), and present an unusual aspect: they are relatively short, mesio-distally compressed and their apexes are not pointed, but wide bucco-lingually and compressed mesio-distally (Extended Data Fig. 1e). M^2 has two partly fused roots: a lingual one and a buccal one that shows a deep vertical groove on its buccal face, and two distinct (buccal and lingual) pulp canals. Though the roots are only partly preserved, the M^3 CCH6-a shows the same pattern as the M^2. However, the other right M^3 CCH9 presents 3 distinct roots (one lingual and two buccal).

Morphometric analysis and comparisons of the dimensions of the CCH teeth with that of *H. sapiens* and fossil hominins of the genus *Homo*, *Paranthropus* and *Australopithecus* show the dimensions of the CCH postcanine maxillary teeth are small to very small in terms of absolute size, and they are mesio-distally compressed (Extended Data Fig. 2, Supplementary Table 1). Computed occlusal surface areas for *Homo luzonensis* P^3 and P^4 are almost equal to each other (Fig. 3a). They are both smaller than those of African and European early *Homo* and Asian early *Homo* (*i.e. H. erectus*) and fit quite comfortably within the lowest part of the range of variation for *H. sapiens*. *H. luzonensis* P^3 is almost equal in size with that of *H floresiensis*, while the P^4 is larger than that of *H. floresiensis*.

The absolute sizes of *H. luzonensis* upper molars are remarkably small (Fig. 3, Extended Data Figs 2d-f, Supplementary Table 1). The occlusal areas for the four CCH upper molars are smaller than that of all comparative specimens belonging to *Australopithecus*, *Paranthropus* and *Homo*, including *H. floresiensis*. The only exceptions are the two M^3s CCH6-a and CCH9 for which two *Homo sapiens* have equal or smaller occlusal area. The molar proportions of *Homo luzonensis* are also very modern, with a strong decrease in size from M^1 to M^3 (Fig. 3a). This pattern is not found in *Australopithecus*, nor *Paranthropus* and it is very rarely encountered in the specimens attributed to the earliest species of the genus *Homo*. In those taxa, M^1 is always smaller than M^2, with M^3 larger or equal to M^2, with the exception of Asian *H. erectus* where M^3 is smaller than M^2. Only the latest species of the genus *Homo*, including *H. sapiens* and *H. neanderthalensis* share the $M^1>M^2>M^3$ pattern seen in *Homo luzonensis*. In the absence of M^3, *H. floresiensis* shows the $M^1>M^2$ pattern.

When the size and proportions of the premolars are compared to those of the molars, *H. luzonensis* falls outside all comparative hominin groups in terms of the general small sizes of its individual teeth, and its large premolars relative to molars (Fig. 3b). Such relative proportions between premolars and molars are not found in extant or fossil hominins. Multivariate analysis of teeth measurements standardized for size (log-shape ratios, see Methods) also demonstrates the unique shape pattern of *H. luzonensis* postcanine maxillary dentition that are characterized by enlarged BL diameter relative to MD diameter, and large premolars relative to molars (Extended Data Figs 2g-i,k). Asian early *Homo* and *Paranthropus* are the closest groups to *H. luzonensis*, but the teeth of these two groups are considerably larger than those of *H. luzonensis*. *Paranthropus* also shows a totally different profile of premolars and molars occlusal surface areas, with a continuous increase in size from P^3 to M^3 (Fig. 3).

H. luzonensis maxillary postcanine teeth resemble those of *H. floresiensis* in several aspects: reduced crown sizes, presence of premolar transverse ridge, and a general morphological contrast between primitive premolars and more derived molars. But the teeth of *H. luzonensis* differ from those of *H. floresiensis* in: absolute and relative crown sizes, absence of a strong mesio-distal compression of M^1, presence of relatively large premolars (*i.e.* compared to molars) with asymmetrical crowns in occlusal view, developed mesial and distal vertical grooves on their buccal aspect, and robust and highly divergent multiple roots. Concerning the mesio-distal compression of M^1, all postcanine maxillary teeth of *H. luzonensis* are mesio-distally compressed, including the M^1 (Extended Data Figs 2, 3). However, the M^1 of *H. luzonensis* is not strongly compressed mesio-distally like in *H. floresiensis* (Extended Data Fig. 3), and it does not differ from its other teeth in this respect (Extended Data Fig. 2).

<u>Intermediate manual phalanx CCH2</u>

CCH2 is an intermediate manual phalanx with a total length of 32.5 mm (Inter-articular length 31 mm; Fig. 2b, Extended Data Figs 5, 6 and Supplementary Table 2). The bone is complete and well preserved but it was recovered broken in two parts just distal to midshaft, and partly covered by calcium carbonate (Extended Data Fig. 5a). The fracture, also covered by calcium carbonate, is an ancient fracture. The bone was virtually reconstructed, after semi-manual segmentation of the two parts (Fig. 2b, Extended Data Fig. 5b). According to the asymmetry of the proximal and distal parts, it presumably belongs to ray 2 to 4 (probably 3) of the left hand. It shows a conspicuous hominin morphology, but it is unique compared to intermediate manual phalanges of Late Pleistocene humans. The shaft is very slender (robusticity index = 19.7, see Methods) and it is particularly narrow. The dorsal and palmar margins of the shaft are longitudinally curved in lateral view. The shaft is compressed dorso-palmarly along its entire length (at midshaft: height = 4.9 mm, breadth = 7.3 mm), and its medial and lateral margins are convergent distally in dorsal view. In plantar view, the sulci for the attachment of fibrous *flexor digitorum superficialis* are very wide, with their maximum width at midshaft where the median bar is very narrow. The sulci extend along the whole length of the shaft, and they are bounded by medial and lateral ridges that are mostly developed along the proximal half of the shaft. The base is wide medio-laterally (total breadth = 12.1 mm). It presents a large dorsal beak that strongly protrudes proximally and extends the height of the base dorsally (total height = 9.5 mm). The proximal articular joint surface has double articular fossae separated by the interarticular keel. The articular surface extends a considerable distance proximo-dorsally under the dorsal beak, and shows a strongly concave profile in lateral and medial views. The normal to the articular surface at its center points in the palmar direction. The head is slightly flattened in the proximodorsal-distopalmar direction. In palmar and dorsal views, the distal margin of the head is regularly concave from medial to lateral due to the shallow and wide intercondylar groove. The distal lateral tubercles are well developed on both sides which gives the head a hexagonal contour in dorsal view, with distally convergent medial and lateral margins of the trochlea. In distal view, the head shows a slight medial torsion relative to the midsagittal plane, and a larger palmar breadth (9.2 mm) than the dorsal one (7.5 mm).

<u>Distal manual phalanx (CCH5)</u>

CCH5 is a distal manual phalanx of 15.9 mm in total length (inter-articular length = 15.6 mm; Fig. 2c, Extended Data Fig. 7 and Supplementary Table 2). The bone is complete and very well preserved, partly covered by calcium carbonate (Extended Data Fig. 7a). Its laterality and ray cannot be determined with certainty, but its proximal articular surface is too small to fit with the distal trochlea of the intermediate manual phalanx CCH2. Although the fact that both phalanges belong to the same individual remains speculative, this comparison might indicate CCH5 belongs to ray 2 or 5. The transverse section of the shaft of CCH5 is almost circular (height = 4.2; breadth = 4.5 at midshaft). Both medial and lateral diaphyseal margins are regularly convex from the palmar to dorsal surfaces, in transverse section. The base has a total breadth of 8.6 mm and a height of 5.9 mm. The outline of the distal tuft is circular rather than oval or “triangular” and its palmar surface presents a rugose ungula tuberosity. CCH5 has an apical tuft expansion index of 68.6 and a robusticity index of 37.8 (see Methods).

Proximal pedal phalanx (CCH4)

CCH4 is a right proximal foot phalanx of ray 2, 3 or 4 (Fig. 2d, Extended Data Fig. 8 and Supplementary Table 2). The bone is complete and very well preserved (Extended Data Fig. 8a). It was largely covered by calcium carbonate and patches of hardened sediment which were cleaned mechanically for the largest patches, then virtually for the remaining smaller patches (see Methods and Extended Data Figs 8b,d). The inter-articular length of CCH4 is 26.5 mm (maximum length 27.4 mm). The shaft shows marked curvatures of both dorsal and plantar aspects in lateral view and parallel lateral and medial margins in dorsal view. The shaft is almost circular at midshaft (height = 5.4; breadth = 5.9) with a small medular cavity, and it is dorsoplantarly compressed in its distal third, with a very small medular cavity and thickened cortical bone (Extended Data Fig. 8d). In plantar view, medial and lateral sulci for the attachments of the fibrous sheaths of the *flexor digitorum longus* and *brevis* muscles are well developed on the distal two-thirds of the shaft, reaching their maximum of extension at its distal third. They are bounded on both sides by marked crests extending along the whole diaphysis medially, and the distal half laterally. The crests are located medio-plantarly and latero-plantarly rather than at the medial and lateral diaphyseal margins. The base of the phalanx shows reduced proportions compared to the rest of the bone (medio-lateral diam. = 9.9 mm; dorso-plantar diam. = 9.3 mm). It is bordered dorso-distally by a shallow medio-lateral sulcus forming a shallow concavity visible in lateral view, proximal to the dorsal convexity of the shaft. The plantar tubercles for attachment of the collateral ligaments of the metatarsophalangeal articulation are well developed, especially the medial one that shows a proximo-distally elongated ridge-like morphology. The proximal joint surface presents a very circular outline, bounded dorsally by a clear rim. This rim, combined with the dorsally canted joint surface and the longitudinal curvature of the dorsal diaphyseal surface, results in a transverse dorsal sulcus that extends medio-laterally. In lateral and medial views, the sulcus is visible as a shallow concavity at the proximal shaft, where it joins the base. The dorsal canting angle of the proximal joint surface is 94.5°, and the articular angle (which does not take into account the morphology of the plantar tubercles) is 89,6 ° (Methods, Extended Data Figs 8f-g). Both values are very low and approximate the *Australopithecus* condition, well below the ranges of variation seen in all other hominins. The head is small relative to the size of base and shaft, and it is compressed in the proximodorsal-distoplantar direction. The head is trochleiform with two distinct condyles, and it has a larger plantar breadth (7.5 mm) than its dorsal one (4.4 mm).

Intermediate pedal phalanx (CCH3)

CCH3 is a small intermediate pedal phalanx – probably ray 2 or 3 of a left foot – with a total length of 16.3 mm (Inter-articular length = 14.9 mm; Fig. 2e, Extended Data Fig. 9 and Supplementary Table 2). The bone is complete and very well preserved, with small patches of calcium carbonate present on its dorsal and proximal aspects (Extended Data Figs 8a-b). The base is 7.7 mm dorsoplantarly and 9.2 mm mediolaterally. The proximal joint surface has two articular facets separated by a weak interarticular keel. The shaft tapers regularly from proximal to distal in lateral view, and its medial and lateral margins converge distally. The head is very small and the condyles show very circular contours in lateral and medial views.

Femoral shaft (CCH7)

CCH7 is a partial femur, with both epiphyses missing (Extended Data Figs 10a-b). The external surface of the bone is partly covered by patches of calcium carbonate, and it presents a black coating due to manganese oxide. The shaft is complete, but it has a transverse fracture in its distal quarter. This fracture presumably occurred during the excavation, and the two diaphyseal fragments refit perfectly. The morphology of CCH7 is typically human, with a very weak but distinct *linea aspera* (Fig. 2h, Extended Data Fig. 10). The dimensions of the shaft are small: while almost the whole shaft is preserved, it is only 160 mm long, with an antero-posterior diameter of 14.8 mm and a medio-lateral diameter of 16.7 mm at midshaft. The transverse section at midshaft is almost circular and the posterior face regularly flattens distally until the fracture that is just proximal to the distal epiphysis (Extended Data Fig. 10c). In anterior and posterior views, there is a slight medio-lateral curvature of the long axis.

Supplementary Table 1 CCH teeth: dental crown dimensions (in mm, BL = bucco-lingual diameter; MD = mesio-distal diameter; MD corrected for interproximal wear)

Specimen No	P^3		P^4		M^1		M^2		M^3	
	BL	MD	BL	MD	BL	MD	BL	MD	BL	MD
CCH6	9.9	6.7	10.2	6.6	10.1	8.6	10.5	8	9.7	7.5
CCH8*	10.1	6.8	-	-	-	-	-	-	-	-
CCH9	-	-	-	-	-	-	-	-	9.7	7.2

*CCH8 is a P^3 or a P^4 (see main text and supplementary information)

Supplementary Table 2 CCH manual and pedal phalanges: determination and dimensions (in mm, in brackets: estimations; R=right, L=left)

Specimen No	determination	ray	side	total length	Inter-artircular length (IA)	midshaft height	midshaft breadth	base height	base breadth	Trochlea/ tuft height	Trochlea/ tuft breadth
CCH2	intermediate manual phalanx	2 to 4 (3?)	L	(32.5)	(31)	4.9	7.3	9.5	12.1	5.2	9.2
CCH5	distal manual phalanx	2 to 5 (2 or 5?)	?	15.9	15.6	4.2	4.5	5.9	8.6	4.2	5.9
CCH4	proximal pedal phalanx	2 to 4	R	27.4	26.5	5.4	5.9	9.3	9.9	4.2	7.1
CCH3	intermediate pedal phalanx	2 or 3?	L?	16.3	14.9	4.1	6.5	7.7	9.2	5.3	7.5

Supplementary Table 3 comparative morphology of the diagnostic features of *H. luzonensis sp. nov.* (based on this study and additional sources indicated in “ref.”; for conservative reasons, taxonomic assignation of hand remains OH7 and several SKX are considered as “*Paranthropus* / early *Homo*”)

	Homo luzonensis sp. nov.	*H. floresiensis*	*H. sapiens*	*H. neanderthalensis*	Asian early *Homo*	African and European early *Homo*	*Paranthropus*	*Australopithecus*	ref.
TEETH									
P^3 buccal groove(s)	**strong**	absent	absent	moderate	moderate to strong	moderate to strong	strong	strong	[3]
MD expansion of P^4 lingual crown	**strong**	moderate	absent	strong	strong	strong	strong	strong	[3]
maxillary premolars transverse crest	**partial to continuous**	partial	absent	partial to continuous	partial to continuous	partial to continuous	partial to continuous	partial to continuous	[3]
Three-rooted P^3	**present**	absent	absent	absent	variable	variable	present	present (variable)	[1,4]
M^1 and/or M^2 C5	**present**	?	absent	absent	absent	absent	present	absent	[5]
maxillary premolars/molars size ratio	**large**	low	low	low	medium	low	medium	low	
postcanine maxillary teeth MD compressed	**strong**	only M^1	no	no	moderate	no	no	no	[3]
	Homo luzonensis sp. nov.	*H. floresiensis*	*H. sapiens*	*H. neanderthalensis*	Asian early *Homo*	*Paranthropus* / early *Homo*		*Australopithecus*	
HAND BONES									
Distal manual phalanx									
Relative expansion of the apical tuft	**low**	low	low	high	?	high		low	[6]
Robusticity	**weak**	intermediate	weak	strong	?	intermediate		intermediate	[6]
Intermediate manual phalanx					?				
Relative width of the base	**very low**	low	low	high	?	high (SKX) to low (ATD)		low	[6–12]
Relative width of the shaft	**very low**	intermediate	intermediate	intermediate	?	high (OH7, SKX) to intermediate (ATD)		intermediate	[6–12]
Relative width of the head	**very low**	low	low	high	?	high (OH7, SKX) to intermediate (ATD)		low	[6–12]
dorsal beak	**present**	absent	absent	absent	?	absent (ATD) – incipient (SKX)		absent	
Attachments of the flexor sheath	**strong**	weak	weak	weak	?	strong (OH7, SKX) to low (ATD)		strong	[6–12]
	Homo luzonensis sp. nov.	*H. floresiensis*	*H. sapiens*	*H. neanderthalensis*	Asian early *Homo*	African and European early *Homo*	*Paranthropus*	*Australopithecus*	
FOOT BONES									
third metatarsal									
Proximal facet for cuneiform	**convex**	flat	flat	flat	?	flat	?	flat*	[8,13–16]

size of the base relative to total length	**very small**	large	large	large	?	variable (medium to large)	?	medium	[8,13–16]
Proximal pedal phalanx									
dorsal canting	**low**	High	High	High	?	High	?	low	[8,13–15]
Longitudinal curvature	**strong**	medium	weak	weak	?	weak (ATD6-32)	?	strong	[8,13–15]
lateral and medial sides in dorsal view	**parallel**	parallel	hourglass shape (narrow diaphysis)	hourglass shape (wide diaphysis)	?	hourglass shape (ATD6-32)	?	parallel	[8,13–15]
head size relative the base in lateral view	**small**	small	large	large	?	large	?	small	[8,13–15,17]
sulci for the attachments of the flexor sheath	**distal half to two-thirds of the shaft**	distal half to two-thirds of the shaft (?)	proximal-to-middle shaft	proximal-to-middle shaft	?	proximal-to-middle shaft (ATD6-32)	?	distal half to two-thirds of the shaft	[8,13–15,17]

* convex in a MT4 of *Australopithecus sediba*: DeSilva et al, 2013[16]

Supplementary Table 4 dental metrics: comparative specimens for traditional morphometric analyses of the postcanine maxillary teeth (MD and BL diameters of upper premolars and molars)

Specimens	source of data
Australopithecus	
AL 125-11, AL 161-40, AL 199-1, AL 200-1a, AL 309-8, AL 333-1, AL 333-2, AL 333-86, AL 333W-42, AL 333X-1, AL 417-1d, AL 423-1, AL 442-1, AL 444-2, AL 486-1, AL 651-1, AL 699-1, AL 770-1a	Kimbel et al, 2004[18]
KNMER 30745, KNMER 35231, KNMER 35233, KNMER 35236, KNMER 35238,	Leakey et al, 1998[19]
KNMKP 30498, KNMKP 31717, KNMKP 34725, KNMKP 35839, KNMKP 47954, KNMKP 49388, KNMKP 52120	Leakey et al, 1998[19]; Ward et al, 2013[20]
MLD 11 30, MLD 23, MLD 28, MLD 6	Wood, 1991[21]
SE 1508, Sts 1, Sts 12, Sts 17, Sts 21, Sts 22, Sts 28, Sts 30, Sts 32, Sts 37, Sts 47, Sts 52a, Sts 53, Sts 54, Sts 55, Sts 56, Sts 57, Sts 61, Sts 8, StwH 19b, StwH 2, StwH 45, StwH 6, StwH 73, Stw 53a, TM 1511, TM 1512, TM 1514, TM 1561	Wood, 1991[21]; Curnoe & Tobias, 2006[22]
Taung 1	Wood, 1991[21]
MH1, MH2	Irish et al 2016[23]
Paranthropus	
Omo 18-31, Omo 18-1799, Omo 33-62, Omo 33-63, Omo L28-58, Omo L238-35, Omo L338x-34, Omo L398-2608	Coppens, 1970[24], 1973[25]; Howell, 1969[26] Wood, 1991[21]
KNMCH 1	Wood, 1991[21]
KNMER 1171, KNMER 1804, KNMER 3886A, KNMER 6128, KNMER 733E, KNMER 802I,	Wood, 1991[21]
KNMWT 17000, KNMWT 17400	Leakey & Walker, 1988[27]
KGA10-506, KGA10-525	Suwa et al 1997[28]
OH5, OH30	Wood, 1991[21]; Tobias, 1967[29]
SK 102, SK 13, SK 14, SK 14129a, SK 1590, SK 1591, SK 17, SK 24, SK 28, SK 31, SK 33, SK 36, SK 3975, SK 3977, SK 47, SK 48, SK 49, SK 52, SK 55, SK 55a, SK 65, SK 74c, SK 79, SK 821, SK 822, SK 823, SK 824, SK 825, SK 826a, SK 829, SK 83, SK 832, SK 834, SK 835, SK 836, SK 837, SK 838a, SK 870, SK 872, SK 98, SKX 162, SKX 21841, SKX 26625, SKX 3354-3601-3355, SKX 7781, SK 831a, SK 46	Wood, 1991[21]; Grine, 1989[30]; Robinson, 1956[31]
TM 1517, TM 1517a, TM 1601, TM 1603	Wood, 1991[21]
African and European early *Homo*	
AL 666-1	Kimbel et al., 1997[32]
Omo B39a, Omo L398-573, Omo L894-1, Omo SH1-17, Omo 18-32, Omo P933-1, Omo B23B, Omo L51-2, Omo L51-4, Omo L9-12, Omo W-749	Wood, 1991[21]; Coppens, 1970[24], 1971[33], 1973[25]; Howell, 1969[26]
KNMER 1506, KNMER 1590, KNMER 1805B, KNMER 1808H, KNMER 1813, KNMER 3733, KNMER 807, KNMER 808, KNMER 803, KNMER 62000, KNMER 42703	Kimbel et al., 1997[32]; Wood, 1991[21] Leakey et al., 2012[34]; Spoor et al, 2007[35]
KNMWT 15000	Brown et al., 1985[36]
KGA 11-350, KGA 4-14	Suwa et al 2007[37]
OH13, OH15, OH16, OH21, OH24, OH39, OH44, OH6, OH38, OH41, OH45, OH65	Wood, 1991[21]; Zaim et al., 2011[38]; Tobias, 1991[39]; Clarke, 2012[40]
SE 255, SK 27, SK 80, Stw 75-79, SKX 268, SKX 334, SKX 268, SKX 334	Wood, 1991[21]; Curnoe & Tobias, 2006[22]; Grine, 1989[30]
Rabat	Thoma & Vallois, 1977[41]

D2282, D2700, D4500	Martinon-Torres et al, 2008[42]; Rightmire et al., 2017[43]
TD6 H1, TD6 H3	Bermudez de Castro et al, 1999[44]
Asian early *Homo*	
Bpg 2001-04, Sangiran 7-10, Sangiran 7-27, Sangiran 7-29, Sangiran 7-3 abc, Sangiran 7-30, Sangiran 7-31, Sangiran 7-32, Sangiran 7-35, Sangiran 7-37, Sangiran 7-38, Sangiran 7-40, Sangiran 7-53, Sangiran 7-58, Sangiran 7-8, Sangiran 7-9, Sangiran 11, Sangiran 15b, Sangiran 16,Sangiran 17, Sangiran 4, Sangiran 27, Tjg 1993-05	Zaim et al., 2011[38]; Arif et al., 2002[45]; Indriati & Anton, 2008[46]; Jacob, 1973[47]; Wood, 1991[21]
SOA MM5	van den Bergh et al., 2016[48]
ZKD A1-68, ZKD A2-54, ZKD A3-Upp2, ZKD B1-66, ZKD B1-67, ZKD B4-79, ZKD C2-62, ZKD D1-28, ZKD D1-51, ZKD D2-50, ZKD F2-26, ZKD F2-27, ZKD F3-34, ZKD F4-35, ZKD H2-14, ZKD I1-88, ZKD I1-89, ZKD L1-PA98, ZKD L2-PA99, ZKD L4-304, ZKD N1-312, ZKD OI-PA313, ZKD AN 520, ZKD AN 521	Weidenreich, 1937[49]; Woo & Chia, 1954[50]
Homo neanderthalensis	
Taddeo 2-3, Saccopastore 1, Saccopastore 2	Benazzi et al. 2011[51]; Condemi, 1992[52]
Bourgeois Delaunay 14, Bourgeois Delaunay 8, Arcy III, Genay, Hortus Ill, Hortus IX, Hortus VIII, Hortus Xbis, Hortus XI, La Croze del Dua, La Croze del Dua "dent grise", La Ferrassie 1, La Quina 5, Le Moustier, Monsempron, Monsempron h, Peche de I'Azé, Peyrards 1, Combe Grenal 28, Combe Grenal IX, Combe Grenal XIII	Condemi, 2001[53]; Lumley, 1973[54],Vandermeersch & Garralda, 2000[55]
Spy I, Spy II,	Lumley, 1973[54]
Krapina 100, Krapina 109, Krapina 162, Krapina 166, Krapina 172, Krapina 177 M, Krapina 178 M, Krapina 180, Krapina 197, Krapina 39, Krapina 40, Krapina 42, Krapina 43, Krapina 44, Krapina 51, Krapina 52, Krapina 58, Krapina 97, Krapina 99, Krapina maxA, Krapina maxB, Krapina maxC, Krapina maxD, Krapina maxE, Krapina maxF, Krapina maxJ, Krapina maxM, Krapina maxN, Krapina maxP	Wolpoff, 1979[56]
Shanidar II, Tabun 1, Tabun s1, Tabun sII	Lumley, 1973[54]
Homo sapiens	
32 recent individuals from the Philippines (“Negritos”, n = 15; “non-Negritos”, n=17)	personal data FD, MH-MNHN coll.
Qesem, Skhul I, Skhul II, Skhul IV, Skhul V, Skhul VI, Skhul VII, Skhul X, Qafzeh 5, Qafzeh 6, Qafzeh 7, Qafzeh 8, Qafzeh 9	Hershkovitz et al, 2011[57]; McCown & Keith, 1939[58]; Vandermeersch, 1981[59]
Mladec 47, Mladec 50-51, Mladec 8, Mladec 9	Frayer et al, 2006[60]
DX1, DX12, DX13, DX14, DX16, DX17, DX20, DX21, DX24, DX26, DX28, DX29, DX31, DX35, DX36, DX38, DX39, DX4, DX40, DX41, DX42, DX47, DX5, DX6, DX8	Liu et al, 2015[61]
Keilor, Cohuna, Talgai, Liang Lemdubu, Kanalda	Adam, 1943[62]; Macintosh, 1952a[63], 1952b[64]; Bulbeck, 2005[65]; Storm, 1995[66]
Perak Man, Mai Da Dieu 84M1, Mai Da Dieu 88M5, Mai Da Nuoc 84M1, Gua Alo 1, Gua Alo 2, Gua Jimbe, Gua Kecil, Gua Kepah B183, Gua Kepah C77, Hoekgrot, Braholo 4, Liang Momer E, Liang Toge, Moh Khiew Cave 91-B1, Moh Khiew Cavec 91-B2, Sakai Cave 92-B3, Song Keplek 1, Song Keplek 4, Song Terus 1, Wajak 1, Wajak 2	personal data FD; Matsumura & Zuraina, 1995[67]; Matsumura et al, 2001[68]; Storm, 1995[66]
Homo floresiensis	
Liang Bua 1	Kaifu et al, 2015[69]

Supplementary Table 5 Elliptic Fourier Analysis of M^1: comparative specimens, and source of data (abbreviations for institutions: CESEAP = Center for Southeast Asian Prehistory (Pham Huy Thong Museum), Quang Ninh, Vietnam; NNML = Nationaal Natuurhistorisch Museum, Leiden, Netherland; TFADP = Thai Fine Arts Department, Phimai, Thailand; IAH = Institute of Archaeology, Hanoi, Vietnam; MH-MNHN = Musée de l'Homme-Muséum national d'Histoire naturelle, Paris, France; AMNH = American Museum of Natural History, New York, US)

Specimens	source of data
Homo sapiens	
Pre-LGM	
Wajak: Wajak 1, Wajak 2	personal data JC, NNML coll.
Pre-Neolithic post-LGM	
Con Co Ngua: b05, b11, b12a, b12c, b30, b33a, b36, b47, b63, b78, b84	personal data JC, IAH coll.
Pho Binh Gia: 18504	personal data JC, MH-MNHN coll.
Neolithic continental Southeast Asia	
Ban Non Wat: b24, b299, b310, b632	personal data JC, TFADP coll.
Man Bac: MB05M11, MB05M13, MB05M15, MB7H1M01, MB07H2M02, MB07H2M17, MB07H2M18, MB07H2M32, MB99H02M02	personal data JC, IAH coll.
Metal Age Vietnam	
Doi Son: b06, b08	personal data JC, IAH coll.
Dong Mom: b2B	personal data JC, IAH coll.
Dong Xa: b01, b02, bK1C3, bK2A4, bK2C2, bK2C3, bK2D3	personal data JC, CESEAP coll.
Vinh Quang: b00, b01M01, b01M02, b02M10	personal data JC, IAH coll.
Minh Duc: b01	personal data JC, IAH coll.
Nui Nap: b04, b05, b07, b10KA, b10KB, b18, b23	personal data JC, IAH coll.
Quy Chu: b01, b19, b24, b30	personal data JC, IAH coll.
Metal Age Thailand	
iron Ban Non Wat: b006, b108, b202, b208, b212, b221, b229, b312, b313, b316, b317, b321, b322, b329, b332,b349, b353, b357, b415, b471, b472, b473, b476, b481, b490, b531, b540, b579, b583	personal data JC, TFADP coll.
bronze Ban Non Wat: b042, b049, b056, b092, b094, b128, b132, b157, b178, b182, b245, b248, b265, b276, b405, b414, b430, b435, b443, b445, b522,	personal data JC, TFADP coll.
Recent *Homo sapiens*	
25 recent individuals from Java, Indonesia	personal data JC, AMNH and MH-MNHN coll.
21 recent individuals from Luzon, Philippines ("non-Negritos")	personal data JC, MH-MNHN coll.
14 recent individuals from Luzon, Philippines ("Negritos")	personal data JC, MH-MNHN coll.

5 recent individuals from Andaman (“Negritos”)	personal data JC, AMNH and MH-MNHN coll.
26 recent individuals from Peninsular Malaysia	personal data JC, AMNH coll.
11 recent individuals from Sulawesi, Indonesia	personal data JC, MH-MNHN coll.
9 recent individuals from Sulu, Philippines	personal data JC, AMNH coll.
28 recent individuals from Thailand	personal data JC, AMNH coll.
23 recent individuals from Vietnam	personal data JC, MH-MNHN coll.
Homo floresiensis	
Liang Bua 1	(Kaifu et al, 2015)

Supplementary Table 6 geometric morphometric analyses of the Enamel Dentine Junction of upper premolars and molars: comparative specimens and source of data.

specimens	tooth	provenance	source of data
Homo erectus			
CA 770	M^1	Sangiran (Indonesia)	original
CA 775	M^2	Sangiran (Indonesia)	original
NG91-G10 n°01	M^1	Sangiran (Java)	Zanolli, 2015[70]
Sangiran 7-3	P^4-M^2	Sangiran (Indonesia)	original
Sangiran 4	P^3-M^2	Sangiran (Indonesia)	Zanolli et al, 2018[71]
Homo neanderthalensis			
KRD 38	P^3	Krapina (Croatia)	NESPOS[72]
KRD 39	P^3	Krapina (Croatia)	NESPOS[72]
KRD 43	P^3	Krapina (Croatia)	NESPOS[72]
KRD 45	P^3	Krapina (Croatia)	NESPOS[72]
KRD 48	P^3	Krapina (Croatia)	NESPOS[72]
KRD 41	P^4	Krapina (Croatia)	NESPOS[72]
KRD 42	P^4	Krapina (Croatia)	NESPOS[72]
KRD 44	P^4	Krapina (Croatia)	NESPOS[72]
KRD 46	P^4	Krapina (Croatia)	NESPOS[72]
KRD 47	P^4	Krapina (Croatia)	NESPOS[72]
BD 14	P^4	La Chaise-de-Vouthon (France)	NESPOS[72]
KRD 101	M^1	Krapina (Croatia)	NESPOS[72]
KRD 134	M^1	Krapina (Croatia)	NESPOS[72]
KRD 136	M^1	Krapina (Croatia)	NESPOS[72]
KRD 171	M^1	Krapina (Croatia)	NESPOS[72]
KRD 174	M^1	Krapina (Croatia)	NESPOS[72]
KRD 96	M^2	Krapina (Croatia)	NESPOS[72]
KRD 98	M^2	Krapina (Croatia)	NESPOS[72]
KRD 135	M^2	Krapina (Croatia)	NESPOS[72]
KRD 165	M^2	Krapina (Croatia)	NESPOS[72]
KRD 166	M^2	Krapina (Croatia)	NESPOS[72]
KRD 169	M^2	Krapina (Croatia)	NESPOS[72]
Homo floresiensis			
LB1	P^3	Liang Bua (Indonesia)	Pusat Penelitian Arkeologi Nasional, Kaifu et al, 2015[69]
fossil *Homo sapiens*			
Qafzeh 4	P^3- P^4	Qafzeh (Israel)	original
Qafzeh 10	P^3- M^1	Qafzeh (Israel)	ESRF[73]
Qafzeh 15	P^3- M^1	Qafzeh (Israel)	ESRF[73]
extant *Homo sapiens*			

extant humans (8)	P^3	worldwide	original
extant humans (9)	P^4	worldwide	original
extant humans (7)	M^1	worldwide	original
extant humans (9)	M^2	worldwide	original

Supplementary Table 7 geometric morphometric analysis of proximal pedal phalanges: comparative specimens and source of data ([m] = mirrored 3D models of left proximal pedal phalanges; "coll. MH-MNHN" = collections of Musée de l'Homme-Muséum national d'Histoire naturelle, Paris)

Specimen	ray number	details (individual, geographical group or species)	origin of 3D model, reference
H. floresiensis			
LB1/36	?(2, 3 or 4)	LB1 (holotype)	original (Pusat Penelitian Arkeologi Nasional), Jungers et al., 2009[15]
LB1/38	2(?)	LB1 (holotype)	original (Pusat Penelitian Arkeologi Nasional), Jungers et al., 2009[15]
Australopithecus			
AL333-115g	2 [m]	*A. afarensis*	cast (coll. MH-MNHN), Latimer et al, 1982[74]
AL333-115h	3 [m]	*A. afarensis*	cast (coll. MH-MNHN), Latimer et al, 1982[74]
AL333-115i	4 [m]	*A. afarensis*	cast (coll. MH-MNHN), Latimer et al, 1982[74]
AL333-26	?(2, 3 or 4)	*A. afarensis*	cast (coll. MH-MNHN), Latimer et al, 1982[74]
AL333-60	?(2, 3 or 4) [m]	*A. afarensis*	cast (coll. MH-MNHN), Latimer et al, 1982[74]
AL333-71	?(2, 3 or 4)	*A. afarensis*	cast (coll. MH-MNHN), Latimer et al, 1982[74]
StW 355	?(2, 3 or 4)	*A. africanus*	cast (coll. GD)
H. sapiens			
8274	2	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9759	2; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9763	4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9764	2; 3	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9765	2; 3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9866	2	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
8280a	2	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
8300	2; 3	Japan (19th)	original (coll. MH-MNHN)
9075	2; 3	Japan (19th)	original (coll. MH-MNHN)
20828	2; 3	Japan (19th)	original (coll. MH-MNHN)
23080	3	Japan (19th)	original (coll. MH-MNHN)
24971	2; 3	Japan (19th)	original (coll. MH-MNHN)
24978	2	Japan (19th)	original (coll. MH-MNHN)
24982	2; 3	Japan (19th)	original (coll. MH-MNHN)
24983	3	Japan (19th)	original (coll. MH-MNHN)
24988	2; 3	Japan (19th)	original (coll. MH-MNHN)
24989	2; 3	Japan (19th)	original (coll. MH-MNHN)
24994	2	Japan (19th)	original (coll. MH-MNHN)
17762	2; 3; 4	western Central Africa (Babinga "pygmies", 19th)	original (coll. MH-MNHN)
18448	4	western Central Africa (Babinga "pygmies", 19th)	original (coll. MH-MNHN)
22257	2; 4	western Central Africa (Babinga "pygmies", 19th)	original (coll. MH-MNHN)
35009	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35011	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35015	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35020	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35024	2; 3; 4	France (1950s)	original (coll. MH-MNHN)

35045	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35060	3; 4	France (1950s)	original (coll. MH-MNHN)
35068	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35071	2; 3; 4	France (1950s)	original (coll. MH-MNHN)
35076	2; 3; 4	France (1950s)	original (coll. MH-MNHN)

Supplementary Table 8 intermediate hand phalanges: comparative specimens for metric analysis and morphological comparisons, and source of data

Specimens	source of data
Australopithecus ("Aus")	
AL333x-18, AL333x-88, AL333x-64, AL333x-46, AL333x-32	Bush et al., 1982[75]
MH2 (UW 88-122, UW 88-161, UW 88-162)	Kivell et al., 2011[76]
StW 331	personal data GD
Paranthropus / early *Homo* ("Par/eH")	
OH7 (FLK NN-F)*	personal data GD
SKX 3062, SKX 35439, SKX9449, SKX13476, SKX36712, SKX5021	Susman et al, 1989[12] (except for interarticular lengths: personal data GD)
African and European early *Homo*("AE-eH")	
ATD-28	Lorenzo et al., 1999[8]
KNM-WT 15000BO*	personal data GD
Homo naledi ("Hna")	
Hand 1 (UW 101-1311, UW 101-1310, UW 101-1308, UW 101-1325)	Kivell et al, 2015[7] (except for interarticular lengths: personal data GD)
Homo neanderthalensis("Hn")	
Kiik-Koba EM176, Kiik-Koba EM175, Kiik-Koba EM174	Musgrave, 1973[77]
Krapina 205.21, Krapina 205.24, Krapina 205.23, Krapina 205.19, Krapina 205.12, Krapina 205.14, Krapina 205.16, Krapina 205.18, Krapina 205.17, Krapina 205.3, Krapina 205.6B, Krapina 205.4, Krapina 205.13, Krapina 205.2A, Krapina 205.1, Krapina 205.6A	Musgrave, 1973[77]
La Ferrassie 1 (left hand, ray 3-5), La Ferrassie 2 (right hand, ray 2-5)	Musgrave, 1973[77]
Homo sapiens ("Hs")	
Anthropological collections (PAPO 74-11)*	personal data GD, University of Poitiers
Arene Candide (right hand, ray 2-5)	Musgrave, 1973[77]
Barma Grande (left hand , ray 2-5; right hand, ray 2)	Musgrave, 1973[77]
chancelade (L2)	
Combe-Capelle (right hand, ray 2-3)	Musgrave, 1973[77]
Tabun 1 (left hand, ray2-3)	Musgrave, 1973[77]
Homo floresiensis ("Hf")	
LB 1 (LB1/40, LB1/48), LB6 (LB6/9)	Larson et al, 2009[6] (except for interarticular lengths: personal data GD)

* visual comparisons only

Supplementary Table 9 geometric morphometric analysis of intermediate manual phalanges: comparative specimens and source of data ("coll. MH-MNHN" = collections of Musée de l'Homme-Muséum national d'Histoire naturelle, Paris)

Specimen	ray number	details (individual, geographical group or species)	origin of 3D model, reference
Australopithecus			
AL333x-64	3?	*A. afarensis*	original (National Museum of Addis Ababa) Bush et al., 1982[75] (coll. GD)
UW 88-122	4	MH2 - *A. sediba*	original (University of the Witwatersrand), Kivell et al., 2011[76] (coll. GD)
UW 88-161	3	MH2 - *A. sediba*	original (University of the Witwatersrand), Kivell et al., 2011[76] (coll. GD)
StW 331	?	*A. africanus ?*	original (University of the Witwatersrand) (coll. GD)
Paranthropus / early *Homo*			
SKX 5021	?	*Member 1, Paranthropus robustus?*	original (Ditsong National Museum of Natural History), Susman et al, 1989[12] (coll. GD)
SKX 9449	?	*Member 1, Paranthropus robustus?*	original (Ditsong National Museum of Natural History), Susman et al, 1989[12] (coll. GD)
SKX 13476	?	*Member 1, Paranthropus robustus?*	original (Ditsong National Museum of Natural History), Susman et al, 1989[12] (coll. GD)
SKX 35439	?	*Member 3, Paranthropus / early Homo*	original (Ditsong National Museum of Natural History), Susman et al, 1989[12] (coll. GD)
SKX 36712	?	*Member 3, Paranthropus / early Homo*	original (Ditsong National Museum of Natural History), Susman et al, 1989[12] (coll. GD)
Homo naledi			
UW 101-1308	4	Hand 1	original (University of the Witwatersrand), Kivell et al, 2015[7] (specimen n°M6590 from MorphoSource)
UW 101-1310	3	Hand 1	original (University of the Witwatersrand), Kivell et al, 2015[7] (specimen n°M6592 from MorphoSource)
UW 101-1311	2	Hand 1	original (University of the Witwatersrand), Kivell et al, 2015[7] (specimen n°M6593 from MorphoSource)
Homo floresiensis			
LB1/48	?	LB1	original (Pusat Penelitian Arkeologi Nasional), Larson et al, 2009[6]
LB6/9	?	LB6	original (Pusat Penelitian Arkeologi Nasional), Larson et al, 2009[6]
H. sapiens			
9757	3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9759	3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9763	2; 3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9764	2; 3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9765	2; 3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9865	3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
9866	2; 3; 4	Philippines ("Negrito", 19th)	original (coll. MH-MNHN)
8300	3; 4	Japan (19th)	original (coll. MH-MNHN)
9075	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
20828	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
23080	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
24971	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
24978	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
24982	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
24983	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
24988	2	Japan (19th)	original (coll. MH-MNHN)
24989	3; 4	Japan (19th)	original (coll. MH-MNHN)
24994	2; 3; 4	Japan (19th)	original (coll. MH-MNHN)
25000	3; 4	Japan (19th)	original (coll. MH-MNHN)

22257	2; 3; 4	western Central Africa (Babinga "pygmies", 19th)	original (coll. MH-MNHN)
17980	2; 3; 4	western Central Africa (Babinga "pygmies", 19th)	original (coll. MH-MNHN)

Supplementary Table 10 distal hand phalanges: comparative specimens for metric analysis and morphological comparisons, and source of data

Specimens	source of data
Australopithecus ("Aus")	
AL333w-11, AL333-50	Bush et al., 1982[75]
MH2 (UW 88-111)	Kivell et al., 2011[76]
Paranthropus / early *Homo* ("Par/eH")	
OH7 (FLK NN-B), OH7 (FLK NN-C)	personal data GD
SKX 27504	Susman et al, 1989[12] (except for interarticular lengths and basal breadth: personal data GD)
Homo naledi ("Hna")	
Hand 1 (UW 101-1329, UW 101-1722, UW 101-1723, UW 101-1724)	Kivell et al, 2015[7] (except for interarticular lengths: personal data GD)
Homo neanderthalensis ("Hn")	
Kiik-Koba EM180, Kiik-Koba EM179,	
Krapina 206.1, Krapina 206.12, Krapina 206.9B, Krapina 206.6, Krapina 206.2,Krapina 206.5, Krapina 206.8, Krapina 206.3, Krapina 206.10, Krapina 206.9A	Musgrave, 1973[77]
La Ferrassie 1 (left hand, ray 2-5)	Musgrave, 1973[77]
Homo sapiens ("Hs")	
Anthropological collections (PAPO 74-53, PAPO74-11)*	personal data GD, University of Poitiers
Arene Candide (right hand, ray 2-5)	Musgrave, 1973[77]
Barma Grande (right hand, ray 2-5)	Musgrave, 1973[77]
Combe-Capelle (right hand, ray 2-3)	Musgrave, 1973[77]
Homo floresiensis ("Hf")	
LB6 (LB 6/7, LB 6/12)	Larson et al, 2009[6] (except for interarticular lengths: personal data GD)

* visual comparisons only

Supplementary Table 11 proximal pedal phalanges: comparative specimens for metric analysis and morphological comparisons, and source of data

Specimens	source of data
Australopithecus ("Aus")	
AL 333-26, AL 333-60, AL 333-71, AL 333-115h, AL 333-115i, AL 333-115j, AL 333-145, AL 333-154, AL 333-167, AL 333-168	articular angle: Trinkaus & Patel, 2016[17]; dorsal canting: personal data GD
StW 355	articular angle: Trinkaus & Patel, 2016[17]; dorsal canting: personal data GD
Paranthropus / early *Homo* ("Par/eH")	
SKX 16699	articular angle: Trinkaus & Patel, 2016[17]
Homo neanderthalensis("Hn")	
Amud 15 (ray3)	articular angle: Trinkaus & Patel, 2016[17]
Denisova 5	articular angle: Trinkaus & Patel, 2016[17]
Kiik-Koba 1 (left foot ray 2-5; right foot ray 2-4)	articular angle: Trinkaus & Patel, 2016[17]
Krapina 251.1, Krapina 253.1, Krapina 253.2, Krapina 253.4, Krapina 253.5, Krapina 253.6, Krapina 253.7, Krapina 253.8, Krapina 253.9, Krapina 253.1, Krapina 253.11, Krapina 253.12, Krapina 253.13, Krapina 253.14, Krapina 253.15, Krapina 253.16	articular angle: Trinkaus & Patel, 2016[17]
La Chapelle-Aux-Saints 1 (right foot, ray 3 and 5)	articular angle: Trinkaus & Patel, 2016[17]
La Ferrassie 1 (right foot, ray 2 and 3; left foot, ray 3 and 4)	articular angle: Trinkaus & Patel, 2016[17]
Regourdou 1 (right foot ray 2 and ray 2 -3), Regourdou 1 (ray2-3)	articular angle: Trinkaus & Patel, 2016[17]
Shanidar 3 (ray2)	articular angle: Trinkaus & Patel, 2016[17]
Subalyuk 1	articular angle: Trinkaus & Patel, 2016[17]
Tabun 1 (right foot, ray 2-4)	articular angle: Trinkaus & Patel, 2016[17]
Homo naledi ("Hna")	
Foot 4 (UW 101-1013) and isolated elements: UW 101-082, UW 101-504, UW 101-1395, UW 101-1441, UW 101-1452	articular angle: Trinkaus & Patel, 2016[17]; dorsal canting: Harcourt-Smith et al., 2015[14]
Homo sapiens ("Hs")	
Recent individuals from the Philippines (“Negritos”, n =23 for 6 individuals), Central Africa (Babinga “pygmies”, n=13 for 3 individuals), and French and Japanese individuals (n= 59 for 21 individuals)	personal data GD (coll. MH-MNHN)
Dolní Věstonice 15 (ry2), Dolní Věstonice 15 (ry3), Dolní Věstonice 15 (ry5), Dolní Věstonice 16 (ry4), Dolní Věstonice 16 (ry5)	articular angle: Trinkaus & Patel, 2016[17]
Ohalo 2 (ry3), Ohalo 2 (ry3), Ohalo 2 (ry4), Ohalo 2 (ry5), Ohalo AD87 (ry3)	articular angle: Trinkaus & Patel, 2016[17]
Qafzeh 6 (ray2), Qafzeh 8 (left foot, ray 2-5; right foot, ray 3-5), Qafzeh 9 (right foot, ray 4; left foot; ray 3-4)	articular angle: Trinkaus & Patel, 2016[17]
Tianyuan 1 (ray2 and 5)	articular angle: Trinkaus & Patel, 2016[17]
Homo floresiensis ("Hf")	
LB1 (LB1/36, LB1/37, LB1/38)	articular angle and dorsal canting: personal data GD

Supplementary Table 12 intermediate pedal phalanges: comparative specimens for morphological comparisons, and source of data

Specimens	source of data
Australopithecus	
AL333w-21a	personal data GD
Homo sapiens	
Anthropological populations (PAPO 74-11)	personal data GD, University of Poitiers
Homo floresiensis	
LB 1 (LB1/15, LB1/99, LB1/56)	personal data GD

References

1. Wood, B. A. & Engleman, C. A. Analysis of the dental morphology of Plio-Pleistocene hominids. V. Maxillary postcanine tooth morphology. *J. Anat.* **161**, 1 (1988).
2. Monsarrat, P. *et al.* Interrelationships in the Variability of Root Canal Anatomy among the Permanent Teeth: A Full-Mouth Approach by Cone-Beam CT. *PLOS ONE* **11**, e0165329 (2016).
3. Kaifu, Y. *et al.* Unique Dental Morphology of *Homo floresiensis* and Its Evolutionary Implications. *PLOS ONE* **10**, e0141614 (2015).
4. Moore, N. C., Thackeray, J. F., Hublin, J.-J. & Skinner, M. M. Premolar root and canal variation in South African Plio-Pleistocene specimens attributed to Australopithecus africanus and Paranthropus robustus. *J. Hum. Evol.* **93**, 46–62 (2016).
5. Ortiz, A., Bailey, S. E., Hublin, J.-J. & Skinner, M. M. Homology, homoplasy and cusp variability at the enamel–dentine junction of hominoid molars. *J. Anat.* **231**, 585–599 (2017).
6. Larson, S. G. *et al.* Descriptions of the upper limb skeleton of *Homo floresiensis*. *J. Hum. Evol.* **57**, 555–570 (2009).
7. Kivell, T. L. *et al.* The hand of *Homo naledi*. *Nat. Commun.* **6**, 8431 (2015).
8. Lorenzo, C., Arsuaga, J. L. & Carretero, J. M. Hand and foot remains from the Gran Dolina early Pleistocene site (Sierra de Atapuerca, Spain). *J. Hum. Evol.* **37**, 501–522 (1999).
9. Walker, A. & Leakey, R. E. *The Nariokotome* Homo erectus *skeleton*. (Harvard University Press, 1993).
10. Susman, R. L. & Creel, N. Functional and morphological affinities of the subadult hand (OH 7) from Olduvai Gorge. *Am. J. Phys. Anthropol.* **51**, 311–331 (1979).
11. Napier, J. Fossil hand bones from Olduvai Gorge. *Nature* **196**, 409–411 (1962).
12. Susman, R. L. New hominid fossils from the Swartkrans formation (1979–1986 excavations): Postcranial specimens. *Am. J. Phys. Anthropol.* **79**, 451–474 (1989).
13. Stern, J. T. J. & Susman, R. L. The locomotor anatomy of *Australopithecus afarensis*. *Am. J. Phys. Anthropol.* **60**, 279–317 (1983).
14. Harcourt-Smith, W. E. H. *et al.* The foot of *Homo naledi*. *Nat. Commun.* **6**, 8432 (2015).
15. Jungers, W. L. *et al.* Descriptions of the lower limb skeleton of *Homo floresiensis*. *J. Hum. Evol.* **57**, 538–554 (2009).
16. DeSilva, J. M. *et al.* The lower limb and mechanics of walking in *Australopithecus sediba*. *Science* **340**, 1232999 (2013).
17. Trinkaus, E. & Patel, B. A. An Early Pleistocene human pedal phalanx from Swartkrans, SKX 16699, and the antiquity of the human lateral forefoot. *Comptes Rendus Palevol* **15**, 978–987 (2016).
18. Kimbel, W. H., Rak, Y. & Johanson, D. C. *The skull of Australopithecus afarensis*. (Oxford University Press, 2004).

19. Leakey, M. G., Feibel, C. S., McDougall, I., Ward, C. & Walker, A. New specimens and confirmation of an early age for Australopithecus anamensis. *Nature* **393**, 62–66 (1998).
20. Ward, C. V., Manthi, F. K. & Plavcan, J. M. New fossils of Australopithecus anamensis from Kanapoi, West Turkana, Kenya (2003–2008). *J. Hum. Evol.* **65**, 501–524 (2013).
21. Wood, B. *Koobi Fora Research Project. Volume 4, Hominid cranial remains*. (Clarendon Press, 1991).
22. Curnoe, D. & Tobias, P. V. Description, new reconstruction, comparative anatomy, and classification of the Sterkfontein Stw 53 cranium, with discussions about the taxonomy of other southern African early Homo remains. *J. Hum. Evol.* **50**, 36–77 (2006).
23. Irish, J. D., Hemphill, B. E., de Ruiter, D. J. & Berger, L. R. The apportionment of tooth size and its implications in *Australopithecus sediba* versus other Plio-pleistocene and recent African hominins. *Am. J. Phys. Anthropol.* **161**, 398–413 (2016).
24. Coppens, Y. Les restes d'hominidés des séries inférieures et moyennes des formations pliovillafranchiennes de l'Omo en Ethiopie. *CR Acad Sci Paris* **271**, 2286–2287 (1970).
25. Coppens, Y. Les restes d'hominidés des séries inférieures et moyennes des formations plio-villafranchiennes de l'Omo en Ethiopie (récoltes 1970, 1971 et 1972). *CR Acad Sci Paris* **276**, 1823–1826 (1973).
26. Howell, F. C. Remains of Hominidae from Pliocene/Pleistocene Formations in the Lower Omo Basin, Ethiopia. *Nature* **223**, 1234 (1969).
27. Leakey, R. E. F. & Walker, A. New Australopithecus boisei specimens from east and west Lake Turkana, Kenya. *Am. J. Phys. Anthropol.* **76**, 1–24 (1988).
28. Suwa, G. *et al.* The first skull of Australopithecus boisei. *Nature* **389**, 489–492 (1997).
29. Tobias, P. V. *Olduvai Gorge. Volume 2. The Cranium and Maxillary Dentition of Australopithecus (Zinjanthropus) boisei*. (Cambridge University Press, 1967).
30. Grine, F. E. New hominid fossils from the Swartkrans formation (1979–1986 excavations): Craniodental specimens. *Am. J. Phys. Anthropol.* **79**, 409–449 (1989).
31. Robinson, J. T. *The dentition of the Australopithecinae*. (Transvaal Museum Memoir, 1956).
32. Kimbel, W. H., Johanson, D. C. & Rak, Y. Systematic assessment of a maxilla of *Homo* from Hadar, Ethiopia. *Am. J. Phys. Anthropol.* **103**, 235–262 (1997).
33. Coppens, Y. Les restes d'hominidés des séries supérieures des formations plio-villafranchiennes de l'Omo en Ethiopie. *CR Acad Sci Paris* **272**, 36–39 (1971).
34. Leakey, M. G. *et al.* New fossils from Koobi Fora in northern Kenya confirm taxonomic diversity in early Homo. *Nature* **488**, 201–204 (2012).
35. Spoor, F. *et al.* Implications of new early Homo fossils from Ileret, east of Lake Turkana, Kenya. *Nature* **448**, 688–691 (2007).
36. Brown, F., Harris, J., Leakey, R. & Walker, A. Early Homo erectus skeleton from west Lake Turkana, Kenya. *Nature* **316**, 788–92 (1985).

37. Suwa, G. *et al.* Early Pleistocene Homo erectus fossils from Konso, southern Ethiopia. *Anthropol. Sci.* **115**, 133–151 (2007).
38. Zaim, Y. *et al.* New 1.5 million-year-old Homo erectus maxilla from Sangiran (Central Java, Indonesia). *J. Hum. Evol.* **61**, 363–376 (2011).
39. Tobias, P. V. *Olduvai Gorge. Volume 4. The Skulls, Endocasts, and Teeth of Homo Habilis*. **4**, (Cambridge University Press, 1991).
40. Clarke, R. J. A Homo habilis maxilla and other newly-discovered hominid fossils from Olduvai Gorge, Tanzania. *J. Hum. Evol.* **63**, 418–428 (2012).
41. Thoma, A. & Vallois. Les dents de l'Homme de Rabat. *Bull. Mém. Société Anthropol. Paris* **4**, 31–58 (1977).
42. Martinón-Torres, M. *et al.* Dental remains from Dmanisi (Republic of Georgia): Morphological analysis and comparative study. *J. Hum. Evol.* **55**, 249–273 (2008).
43. Rightmire, G. P., Ponce de León, M. S., Lordkipanidze, D., Margvelashvili, A. & Zollikofer, C. P. E. Skull 5 from Dmanisi: Descriptive anatomy, comparative studies, and evolutionary significance. *J. Hum. Evol.* **104**, 50–79 (2017).
44. Bermúdez de Castro, J. M., Rosas, A. & Nicolás, M. E. Dental remains from Atapuerca-TD6 (Gran Dolina site, Burgos, Spain). *J. Hum. Evol.* **37**, 523–566 (1999).
45. Arif, J. *et al.* Preliminary observation of a new cranium of Homo erectus (Tjg-1993.05) from Sangiran, Central Jawa. *Anthropol. Sci.* **110**, 165–177 (2002).
46. Indriati, E. & Antón, S. C. Earliest Indonesian facial and dental remains from Sangiran, Java: a description of Sangiran 27. *Anthropol. Sci.* **116**, 219–229 (2008).
47. Jacob, T. Palaeoanthropological discoveries in Indonesia with special reference to the finds of the last two decades. *J. Hum. Evol.* **2**, 473–485 (1973).
48. van den Bergh, G. D. *et al. Homo floresiensis*-like fossils from the early Middle Pleistocene of Flores. *Nature* **534**, 245–248 (2016).
49. Weidenreich, F. The Dentition of Sinanthropus pekinensis: a comparative odontography of the Hominids. *Palaeontol. Sin. New Ser. D* **1**, 1–121 (1937).
50. Woo, J. K. & Chia, L. P. New discoveries about *Sinanthropus pekinensis* in Choukoutien. *Acta Palaeontol. Sin.* **2**, 267–288 (1954).
51. Benazzi, S. *et al.* A reassessment of the Neanderthal teeth from Taddeo cave (southern Italy). *J. Hum. Evol.* **61**, 377–387 (2011).
52. Condemi, S. *Les hommes fossiles de Saccopastore et leurs relations phylogénétiques*. (CNRS Éditions, 1992).
53. Condemi, S. *Les Néandertaliens de la Chaise : abri Bourgeois-Delaunay*. (Éd. du Comité des travaux historiques et scientifiques : Société préhistorique française, 2001).
54. De Lumley, M. A. *Anténéandertaliens et néandertaliens du bassin méditerranéen occidental européen*. (Université de Provence, 1973).

55. Vandermeersch, B. & Garralda, M. D. Les Néandertaliens de la grotte de Combe-Grenal (Domme, Dordogne, France) / The Neanderthals from Combe-Grenal cave (Domme, Dordogne, France). *Paléo* **12**, 213–259 (2000).
56. Wolpoff, M. H. The Krapina dental remains. *Am. J. Phys. Anthropol.* **50**, 67–113 (1979).
57. Hershkovitz, I. *et al.* Middle pleistocene dental remains from Qesem Cave (Israel). *Am. J. Phys. Anthropol.* **144**, 575–592 (2011).
58. McCown, T. D. & Keith, A. *The Stone Age Man of Mount Carmel: The Fossil Human Remains from the Levalloiso-Mousterian - Volume II*. (Clarendon Press, 1939).
59. Vandermeersch, B. *Les hommes fossiles de Qafzeh (Israël)*. (Editions du CNRS, 1981).
60. Frayer, D. W., Jelínek, J., Oliva, M. & Wolpoff, M. H. Aurignacian male crania, jaws and teeth from the Mladeč Caves, Moravia, Czech Republic. in *Early modern humans at the Moravian Gate, the Mladeč Caves and their remains* 185–272 (2006).
61. Liu, W. *et al.* The earliest unequivocally modern humans in southern China. *Nature* **526**, 696–699 (2015).
62. Adam, W. The Keilor Fossil Skull : Palate and Upper Dental Arch. *Mem. Natl. Mus. Vic.* **13**, 71-77. (1943).
63. Macintosh, N. W. G. The Talgai skull and dental arch : remeasurment and reconstruction. *Oceania* **23**, 106–9. (1952).
64. Macintosh, N. W. G. The Cohuna Cranium: Teeth and Palate. *Oceania* **23**, 95–105 (1952).
65. Bulbeck, D. The Last Glacial Maximum human burial from Liang Lemdubu in northern Sahulland. *Archaeol. Aru Isl. East. Indones.* 255–294 (2005).
66. Storm, P. *The evolutionary significance of the Wajak skulls.* **110**, (Nationaal Natuurhistorisch Museum, 1995).
67. Matsumura, H. & Zuraina, M. Metrical analysis of the dentition of Perak man from Gua Gunung Runtuh in Malaysia. *Bull. Natl. Sci. Mus. Tokyo Ser. D* **21**, 1–10 (1995).
68. Matsumura, H., Cuong, N. L., Thuy, N. K. & Anezaki, T. Dental morphology of the early Hoabinian, the Neolithic Da But and the Metal Age Dong Son civilized peoples in Vietnam. *Z. Für Morphol. Anthropol.* 59–73 (2001).
69. Kaifu, Y. *et al.* Descriptions of the dental remains of *Homo floresiensis*. *Anthropol. Sci.* **123**, 129–145 (2015).
70. Zanolli, C. Molar crown inner structural organization in Javanese *Homo erectus*: Javanese *Homo Erectus* Inner Molar Structure. *Am. J. Phys. Anthropol.* **156**, 148–157 (2015).
71. Zanolli, C. *et al.* Inner tooth morphology of *Homo erectus* from Zhoukoudian. New evidence from an old collection housed at Uppsala University, Sweden. *J. Hum. Evol.* **116**, 1–13 (2018).
72. NESPOS Database. NEanderthal Studies Professional Online Service. (2018). Available at: http://www.nespos.org.

73. European Synchrotron Radiation Facility. ESRF Paleontological Database. (2018). Available at: http://paleo.esrf.eu.
74. Latimer, B. M., Lovejoy, C. O., Johanson, D. C. & Coppens, Y. Hominid tarsal, metatarsal, and phalangeal bones recovered from the Hadar formation: 1974–1977 collections. *Am. J. Phys. Anthropol.* **57**, 701–719 (1982).
75. Bush, M. E., Lovejoy, C. O., Johanson, D. C. & Coppens, Y. Hominid carpal, metacarpal, and phalangeal bones recovered from the Hadar formation: 1974–1977 collections. *Am. J. Phys. Anthropol.* **57**, 651–677 (1982).
76. Kivell, T. L., Kibii, J. M., Churchill, S. E., Schmid, P. & Berger, L. R. Australopithecus sediba Hand Demonstrates Mosaic Evolution of Locomotor and Manipulative Abilities. *Science* **333**, 1411–1417 (2011).
77. Musgrave, J. H. The phalanges of Neanderthal and Upper Palaeolithic hands. in *Human evolution* **11**, 59–85 (Taylor & Francis, 1973).