

## Supplementary Information

### **Infant craniofacial diversity in Early Pleistocene *Homo***

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## **Supplementary Note 1. Contextual information about the undescribed DNH 83, KW 7000 and Omo 222-1973-2744 early *Homo* infants.**

The DNH 83 early *Homo* and DNH 84 *Paranthropus robustus* specimens were discovered in DMQ in 2000. The majority of the hominin remains from DMQ (including DNH 83 and DNH 84) likely date back to the period between approximately 2.04 and 1.95 Ma<sup>1</sup>. The KW 7000 early *Homo* specimen was discovered in Unit P at Kromdraai in two separate pieces: (i) a small fragment of the right mandibular corpus associated with the dm2 in April 2014<sup>2</sup>, (ii) the rest of the mandible, including the symphyseal area in September 2015. These two parts were subsequently reassembled by J. Braga. The associated *P. robustus* sample from Kromdraai Unit P<sup>3,4</sup>, found alongside bone/stone tools and a wide variety of faunal remains, predates the holotype of this species, TM 1517, discovered at this site in 1938<sup>5</sup>. Biochronological assessments of bovid specimens from Kromdraai Unit P consistently indicate an age predating 2 million years ago (Ma) for this assemblage<sup>6</sup>. For more details on the geological and biochronological context of Kromdraai Unit P, see reference 7. Detailed descriptions of the *P. robustus* comparative specimens recovered from DMQ and Kromdraai Unit P and presented in this study are provided in reference 4.

The Omo 222-1973-2744 mandibular fragment was recovered in 1973 and was only very briefly mentioned in an inventory of Pliocene and Pleistocene hominin remains from the lower Omo Basin<sup>8</sup>. There are conflicting reports exist regarding its stratigraphic context. To ensure accuracy, we prioritize the original context provided by its discoverers, F.C. Howell and Y. Coppens, at the time of its discovery. Their 1976 account (ref. 8, page 529) unequivocally states that Omo 222-1973-2744 was recovered from submember G5 of the Shungura formation (Ethiopia). While Feibel et al. (1989)<sup>9</sup> and subsequent authors have suggested that the specimen originated from submember G7, White (1988)<sup>10</sup> considers that Omo 222-1973-2744 “may derive from an adjacent unit” without providing further clarification. Importantly, these discrepancies have no effect on the estimated time range of the Omo 222-1973-2744 specimen.

The base of Member G is marked by Tuff G, which has been dated to  $2.33 \pm 0.03$  Ma using the  $^{40}\text{Ar}/^{39}\text{Ar}$  method<sup>9</sup>. Submember G-9 corresponds to the top of the Reunion I normal magnetozone, dated at 2.15 Ma. Consequently, the fossils from Member G span an approximate age range of 2.31 to 2.10 Ma.

## **Supplementary Note 2. Additional descriptions.**

### DNH 83

The dm<sup>1</sup> is well-preserved. A tiny crack crosses through the distal cusps. The tooth appears to have just erupted in the mouth although not completely. Wear is minimal with facets on the lingual side of the paracone, on the lingual side of the protocone, on the preprotocrista, and on the mesial marginal ridge. The occlusal outline is circular, with a mesio-buccal extension. The

four main cusps are evident. The protocone is the largest, followed by the paracone, slightly larger than the metacone, whereas the hypocone is markedly reduced. A strongly developed parastyle is evident, clearly separated from the paracone by a deep groove, with its own free cusp tip. The mesial marginal ridge is worn and thick. The fovea anterior is a thin and deep fissure, occupied by a thin epicrista that moves from the parastyle to the protocone tip. The presence of this crest creates what is sometimes referred to as a double fovea anterior. The central fossa is broad and deep. There is no *crista obliqua* and the longitudinal fissure is continuous. The fovea posterior is at a different level from the trigon. It is a thin and shallow fissure. It is bounded by a thick and low distal marginal ridge. No additional cuspules are evident. On the buccal face, the mesiobuccal groove is marked and deep, delimiting the parastyle. At its end, a well-developed tuberculum molare is present. The distobuccal groove is long and shallow. On the lingual face, the lingual groove is long, shallow and ends gradually. A slight protuberance on the mesiolingual corner hints at the presence of a Carabelli trait. A band of hypoplastic pits is present. Similar pits are also evident on the mesial and the distal faces.

The occlusal outline of the  $dm^2$  is almost square. The main cusps are evident. The protocone is the largest cusp, followed by the paracone and the metacone; the hypocone is markedly developed. The mesial marginal ridge is very thick with a well-defined mesioconule partly occupying a deep anterior fovea. The latter encroaches the mesial marginal ridge mesial to the paracone tip, delineating a mesiostyle (sensu ref. 11). A thick epicrista, incised in its midpart, bounds the anterior fovea. The central fovea is very deep and broad. The *crista obliqua* is very thick, low, and incised at its lowest point by the longitudinal fissure. A well-defined cuspule is also present on it, between the longitudinal fissure and the metacone tip. The posterior fovea is broad and deep, occupied by enamel ridges emanating from the metacone tip and the hypocone tip. The distal marginal ridge is narrow, incised in its midpart, with an incipient C5. On the buccal face, the buccal groove is short and deep, ending into a broad pit delimited by a thick enamel shelf. On the lingual face, the lingual groove is long and very deep, terminating into a broad pit delimited by a thick enamel shelf that extends mesially and lingually. On the mesiolingual corner, two furrows delineate an incipient cuspule indicating the presence of a Carabelli's trait.

The mesiodistal (MD) and buccolingual (BL) diameters of the  $dm^2$  crown fall outside the distribution for *P. robustus* (Supplementary Figure 2). This tooth lacks BL expansion and it has BL dimensions like SE 255, SKX 267 and SK 27, three specimens from South Africa attributed to early *Homo*.

The combined morphological evidence of the  $dm^1$  and  $dm^2$  points to the allocation of this specimen to the genus *Homo*. In both teeth the paracone is slightly larger than the metacone, whereas in *Paranthropus* they have usually similar size; the mesiobuccal groove is marked, whereas in *Paranthropus* is weakly expressed.

The size of the 'apical area' (bounded in the lateral direction by the location of the mesial faces of the deciduous canines)<sup>12</sup> can be estimated by the sum of the deciduous incisors' ( $di^{1-2}$ )

mesiodistal (MD) alveolar diameters. This value is 7.81 mm in DNH 83, and 10.08 mm in DNH 47.

In DNH 83, visual inspection reveals no trace of the anterior component of the incisive suture (see ref. 13, and references therein) which was completely fused, as confirmed by a synchrotron tomography with an oblique slice passing through the crypts of the developing permanent incisors ( $I^{1-2}$ ) (Supplementary Figure 4b). Only a short remnant (c. 5 mm) of the suture is manifested as a hypodense gap located immediately behind the crypt of the developing  $I^2$ . This feature is commonly observed among modern humans and corresponds to the palatal component of the incisive suture. In DNH 83, the palatal component of the incisive suture extends from the  $di^2$ -dc interalveolar septum to the nasomaxillary suture (Fig. 2). In DNH 47, a short segment of the anterior component of the incisive suture is visible near the piriform aperture<sup>12</sup>. Synchrotron tomography (Supplementary Figure 4d) reveals its S-shaped course between the premaxilla and the maxilla, as marked by a succession of short hypodense gaps located immediately behind the crypts of the developing  $I^{1-2}$ . The formation of dense bone between these gaps indicates that the incisive suture was largely fused in DNH 47.

The ‘apical area’ of the premaxilla is 29% smaller in DNH 83 than in DNH 47. In DNH 83, inferior orbital margin is preserved for about 12 mm and protrudes forward slightly, leading to a groove below it and along the frontal process of the maxilla. From the inferior orbital margin, the bone forms a flat surface leading to the inferomedially positioned infraorbital foramen, with no maxillary furrow (fossula)<sup>14</sup>. The base of the zygomatic process (with its inferiorly concave zygomaticoalveolar crest) is oriented anteroinferiorly, with its anterior take-off positioned over the anterior part of the  $dm^1$ , 5 mm above the alveolar border (Fig. 2, Supplementary Figure 3). The nasoalveolar clivus smoothly curves into the nasal cavity and displays no nasal spine, with higher slopes to the alveolar plane (c. 53°), compared to *P. robustus* (c. 65° in DNH 47) and *Australopithecus* juveniles (e.g., 35° in AL 333-105).

In sagittal view, there is a significant change of relief between the alveolar process (with a maximum thickness of 6.2 mm and maximum length of 14.8 mm) and the hard palate of DNH 83 (Fig. 2, Supplementary Figures 3-5). This configuration is similarly noted in the developmentally older KW 9000 infant<sup>12</sup> (Supplementary Figure 3), yet with two notable disparities that distinguish them from DNH 83. First, the palatal thickness immediately posterior the opening of the nasopalatine canal in DNH 83 (1.2 mm) represents at least half the value measured in the developmentally slightly older KW 10840 (2.5 mm) and KW 9000 (2.9 mm) *P. robustus* infants<sup>12</sup>. Secondly, DNH 83 exhibits a marked angle at both the superoposterior pole of the alveolar process (at the contact with the vomer) and the nasal entrance to the incisive canal, where the process and the hard palate overlap for a length of approximately 4.9 mm (Supplementary Figure 4). This morphology contrasts with the more rounded and uniformly sloping topography observed in *P. robustus* infants<sup>12</sup> (Supplementary Figure 3). In DNH 83, the maximal palatal depth (6 mm) and breadth (14 mm) is measured at level of  $dm^1$ . In the developmentally older KW 9000 *P. robustus* infant, the palate is broader (c. 21 mm) at the level of the  $dm^1$ , whereas palatal depth is similar (6.5 mm).

The only other early *Homo* juvenile which can be compared to DNH 83 is SKW 3114, a left and more fragmentary maxilla recovered from the site of Swartkrans which represents a developmentally slightly older individual<sup>15</sup>. As in DNH 83, the root of the zygomatic arch in SKW 3114 is positioned posteriorly (at the level of the mesial half of the M<sup>1</sup>), when compared to the developmentally comparable DNH 84 (Supplementary Figure 1) and KW 9000 *P. robustus* infant<sup>12</sup> (at the level of the distal half of the dm<sup>1</sup>) (Fig. 1, Supplementary Figure 3).

#### DNH 84

This nearly complete left maxilla retains the empty alveolus for the deciduous canine, the base of the zygomatic process and a portion of the hard palate (Supplementary Figure 1, Supplementary Table 1). The premaxilla is missing. It preserves the erupted dm<sup>1</sup> and dm<sup>2</sup> (the distal part is broken away) with moderate wear, and the developing crowns of I<sup>2</sup> and P<sup>4</sup>. The maxilla is associated with the isolated Rdm<sup>1</sup>, LM<sup>1</sup>, R and LI<sup>1</sup>.

The left dm<sup>1</sup> is in the maxilla and overall is well-preserved (Supplementary Figure 1, 2). The right tooth is isolated. The crown was broken in three pieces that have been glued back together. The roots are largely intact, except for a small fragment missing from the distal face of the mesiobuccal root and from the root tip. The description of the crown refers to the left tooth, of the roots to the right tooth. Wear is minimal, and the cusps are rounded with tiny pits of dentine exposed on the protocone and the paracone. The mesial interproximal contact facet is large, oval and reaches the occlusal margin. The distal interproximal contact facet (as seen on the right tooth) is also large and oval. The occlusal outline is almost square, with a marked mesiobuccal extension. The four main cusps are evident. The protocone is the largest, followed by the paracone and metacone of approximately similar size and then the hypocone. There is a parastyle that merges with a thick mesial marginal ridge. The fovea anterior is reduced to a fissure. It is bounded distally by an enamel ridge emanating from the tip of the paracone. The central fossa is small and deep. The *crista obliqua* is present as a thick ridge of enamel, incised in its central part. The fovea posterior is reduced to a pit that is situated at a different level from the trigon. It is bounded by a worn and thick distal marginal ridge. No additional cuspules are present. A ridge of enamel connecting the metacone to the hypocone is evident. On the buccal face, a weak mesiobuccal groove delineates the parastyle. A small *tuberculum molare* is present. The distobuccal groove is faint, ending gradually. On the lingual face, the lingual groove is deep and terminates with no issue. No obvious Carabelli trait is evident. Tiny hypoplastic pits are visible. The mesio buccal root is long and it shows two radicular canals. The disto buccal root is short, straight and is oval in cross section. The lingual root is long and conical in shape. It is widely divergent from the buccal roots. Root tip curves buccally. Root lengths are as follows: mesio buccal 7.5 (as preserved), disto buccal 6.4, L 8.5.

The Ldm<sup>2</sup> is in the maxilla (Supplementary Figure 1, 2). The crown is broken through the cusp tips of metacone and hypocone, and the distal part of the tooth is missing. The rest of the crown is well preserved. Wear is minimal, with facets evident on the paracone and on the mesial marginal ridge. The protocone and paracone are well developed. The mesial marginal ridge is thick and the

anterior fovea is reduced to a fissure. The central fossa is large and deep. The crista obliqua is thick, and it is incised in its central part. On the buccal face, the buccal groove is faint. From its end, a thin edge of enamel moves on to the paracone. On the lingual face, the lingual groove is deep and terminates with no issue. A Carabelli trait is evident in the form of a deep furrow. Tiny hypoplastic pits are evident. On the maxillary fragment part of the broken lingual root tip are exposed.

The LM<sup>1</sup> is an unworn crown of a developing tooth (Supplementary Figure 1). Preservation is excellent. A few millimeters of root development are evident. The occlusal outline is rhomboidal, with some disto-lingual extension. The main cusps are well-developed. The protocone is the largest cusp, while the paracone, metacone and hypocone are of approximately equal size. The mesial marginal ridge is thin, and it is incised in its central part. It is continuous with an enamel ridge from the tip of the paracone. An additional cuspule is evident on the mesial marginal ridge, flowing into the anterior fovea that is mostly obliterated. The central fossa is deep and broad. The thick crista obliqua is cut by the longitudinal fissure. The fovea posterior is thin and deep, delimited by a thick distal marginal ridge, incised in its midpart. Its most mesial end is cut by a furrow that separates it from the metacone. On the buccal face, the buccal groove is very faint, ending in a tiny pit. From it a thin ridge moves onto the paracone. On the lingual face the lingual groove is very deep and long. On the mesiolingual corner, a Carabelli's trait is present in the form of a furrow.

The developing R and LI<sup>1</sup>s are well preserved, except for a flake of enamel missing near the base of the right tooth (Supplementary Figure 1). Crown formation appears not far from complete. Description refers to the right tooth. The labial face is slightly convex both mesio-distally and inciso cervically. Both corners are rounded, the distal more so than the mesial. The incisal edge has three mamelons of different sizes. Perikymata are visible, but not marked. The lingual face is concave inciso cervically and, less so, mesio-distally. The mesial corner appears more angulated, whereas the distal is more rounded. Both a mesial marginal ridge and a distal marginal ridge are present. The distal marginal ridge is more expressed. The developing crown of the P<sup>3</sup> shows the 'pavement cracking' appearance typical of the immature enamel all over its surface, preventing a detailed description. The occlusal outline is oval. The paracone appears to be larger than the protocone, with the cusp tips on the same plane. The mesial marginal ridge is high. The anterior fovea is deep and narrow. The distal marginal ridge is low. Occurrence of additional cuspules is difficult to ascertain. Similarly, details of the buccal face are not clear. On the developing crown of the P<sup>4</sup>, the cusp tip of the paracone is high. A ridge of enamel moves from the cusp tip to the central fossa. Another ridge, distal to it is evident. The protocone is not formed yet. The mesial marginal ridge is high. The developing crown of the C shows the 'pavement cracking' appearance on its disto-buccal corner. The crown is short and broad. the profile is slightly asymmetrical, with the cusp tip mesial to the midline. The buccal face is convex inciso-cervically and, less so, mesio-distally. On the lingual face a faint median ridge is present, ending halfway. The mesial and the distal marginal ridges are marked.

On the deciduous molars a small *tubeculum molare*, a weak mesiobuccal groove and a paracone similar in size to the metacone point to allocation to *Paranthropus*. Similarly, a reduced MD

dimension is at the lower end of the distribution for *Paranthropus* and outside the range of South African *Homo*.

Only three measurements can be taken on the DNH 84 left maxilla (Supplementary Table 1). They indicate the overall similarity between DNH 84 and the developmentally similar KW 9000 *P. robustus* infant<sup>12</sup>. In DNH 84, the anterior take-off of the zygomatic process (with its inferiorly concave zygomaticoalveolar crest) is positioned over the posterior part of the dm<sup>1</sup>, with its base c. 7 mm above the alveolar border (Supplementary Figure 1).

### KW 7000

The size of the apical area is comparably close in KW 7000 (7.25 mm) and in the developmentally similar KW 6420 *P. robustus* infant (7.36 mm)<sup>12</sup>. Likewise, the sum of the I<sub>1-2</sub> MD is relatively similar in these two specimens (12.3 mm in KW 7000 and 11.9 mm in KW 6420).

The occlusal outline of the dm<sub>2</sub> crown (Fig. 3, Supplementary Data 2) is oval with a marked MD elongation, with the entoconid projecting lingually. All five principal cusps are well developed, with the metaconid and hypoconid being the largest, followed by the protoconid, entoconid, and hypoconulid. The cusp tip of the protoconid is slightly mesially placed to the cusp tip of the metaconid. The cusps form a Y pattern. A well-defined postmetaconulid is present. The mesial marginal ridge is thick and it bears 3 distinct cusplids. The anterior fovea is reduced to a slit, and it is bounded distally by a well-developed continuous mid trigonid crest. The central fovea is broad. The posterior fovea is very deep, bordered by a relatively thin distal marginal ridge, bearing a very faint C6. The mesiobuccal groove is deep and ends into a broad pit – almost a shelf. The distobuccal groove is also deep ending with no issue. On the lingual face, the lingual groove is deep. Some 1.5 mm of the developing root are present.

The MD and BL diameters of dm<sub>2</sub> fall outside the distribution of *P. robustus*, with an MD elongation relative to BL (Supplementary Figure 2). The same observation holds true for the Omo 222-1973-2744 early *Homo* specimen. Please note that DNH 121 is a dm<sub>2</sub> and not a dm<sup>2</sup>, as incorrectly listed in reference 16.

The right I<sub>1</sub> developing crown is well preserved apart from some damage on its disto-buccal edge (Fig. 3). The labial face has a triangular outline, broader near the incisal edge and narrower near the lower part of the crown. It is very slightly convex, almost flat, inciso-cervically and also mesio-distally. It shows the ‘pavement cracking’ appearance typical of the immature enamel.

The incisal edge bears three well defined mammelons. The central is smaller in size whereas the mesial and the distal are larger, of similar size, and pointed, thus creating a very peculiar profile of the incisal margin. The lingual face is also almost flat, both, inciso-cervically and mesio-distally. There are no ridges of any sort present. Two grooves delineate the central mamelon.

The right I<sub>2</sub> developing crown is well preserved, but the distal corner is damaged (Fig. 3). As in the I<sub>1</sub>, the labial face has a triangular outline, broader near the incisal edge and narrower near the lower part of the crown. It is very slightly convex, almost flat, inciso-cervically and also mesio-distally. Inciso-cervical convexity is more marked near the incisal edge. The central part of the

face shows the ‘pavement cracking’ appearance typical of the immature enamel. The incisal edge bears 5 well defined mammelons of different size. As in the  $I_1$ , the mesial is larger and pointed, the 3 central ones of similar size, and the distal large – although damaged. The lingual face is also almost flat, both, inciso-cervically and mesio-distally. Near the crown base faint mesial and distal marginal ridges are present. Faint grooves delineate the mammelons on the incisal edge. The right C developing crown is well preserved (Fig. 3). The labial face has an asymmetrical pentagonoid outline and is slightly convex both inciso-cervically and mesio-distally. The cusp tip is high and sharp. The crown profile is markedly asymmetrical (as in SKX 2356, and contrary to *Paranthropus*), with the distal shoulder more angulated than the mesial one. The lingual face is almost flat, both inciso-cervically and mesio-distally. In the central part of the face a marked median ridge is present, departing from the cusp tip. It has a very sharp edge. This condition differs from *Paranthropus* which has a slight ridge, and it is more similar to *A. afarensis*, where it is described as a strong lingual ridge<sup>17,18</sup> and to *A. africanus*, such as Sts 51<sup>19</sup>. In *H. habilis* from Olduvai (OH 7, OH 13) it is described as a ‘moderate to slight’ central lingual ridge<sup>11</sup>. The *H. ergaster* specimen KNM ER 992 is described as having a canine with a low, flat, median ridge<sup>20</sup>. Finally, a faint distal marginal ridge is present, but it does not end into a true cuspid. MD crown dimension (5.5 mm; Supplementary Data 2) falls very below the lower limit of the observed range for *P. robustus* (6.90-9.10, n=18)<sup>4</sup>.

The  $dm_2$  of KW 7000 differs from the same tooth of the specimen Omo 222-1973-2744 (and other *Homo* specimens from East Africa) in that this has the mesio-buccal groove ending into a shelf, whereas Omo 222-1973-2744, KNM ER 820, KNM ER1507 and GAR IVE have a mesio-buccal groove ending gradually. Also, KW7000 has a continuous midtrigonid crest, whereas Omo 222-1973-2744, GAR IVE, and apparently KNM ER 820 has a midtrigonid crest incised in its midpart.

The minimum distance between the canine alveoli is 12.7 mm, while the distance between the midpoints of the interdental septa separating the  $dm_1$  and  $dm_2$  is 27.6 mm. At the symphysis, the mandible body of KW 7000 attains its maximum height, measuring 21.0 mm, with an anteroposterior depth of 9.8 mm (Supplementary Table 2). On the posterior aspect of the symphysis, a long, c. 45° sloping, planum alveolare leads from the alveolar border to the tall and moderately convex superior transverse torus. This torus is separated inferiorly from the smaller marginal torus by a deep genioglossus pit.

The uniquely derived morphology of KW 7000 is reflected primarily by the vertical inclination and distinctly convex anterior symphyseal face, the anterior positioning of the elongated geniohyoid depressions, the absence of a lateral superior torus and the overall small size and gracility of the corpus (Fig. 3, Supplementary Figure 7).

#### Omo 222-1973-2744

The teeth of Omo 222-1973-2744 have been described by F.E. Grine<sup>11</sup>. The salient features are reported here for convenience.

The dm<sub>1</sub> crown is overall well preserved. Minor cracks cross its surface. Occlusal wear is slight with a tiny island of dentine exposed on the hypoconid. The other cusps have well developed wear facets. The occlusal outline is almost rectangular, with some mesio-buccal extension. The talonid is broader than the trigonid. Five cusps are evident. The protoconid is the largest, followed by the metaconid and the hypoconid; the entoconid and the hypoconulid are smaller. The trigonid is higher than the talonid. The cusp tip of the protoconid is mesially placed to the cusp tip of the metaconid. A small mesioconulid is present mesial to the protoconid cusp tip. The mesial marginal ridge is moderately thick and high, continuous from the protoconid to the metaconid. The fovea anterior is a broad and deep triangular depression mostly located lingually to the midline. The distal trigonid crest is moderately thick, high and shallow incised. The central fovea is broad. There is no fovea posterior nor a distal marginal ridge. On the buccal face a very well-developed tuberculum molare is evident, convex mesiobuccally and cervically. The buccal groove is deep and ends gradually. The lingual face shows a short lingual groove.

The dm<sub>2</sub> crown is overall well preserved. Wear in minimum. The occlusal outline is an elongated oval. The five cusps are evident. The protoconid and the metaconid are the largest, followed by hypoconid, entoconid and hypoconulid of similar size. The protoconid is mesial to the metaconid. The mesial marginal ridge is low and narrow. It is incised by several narrow grooves that delineate three separate cuspid. The fovea anterior is broad, bounded distally by an incised distal trigonid crest. The central fovea is broad. There is no fovea posterior nor a distal marginal ridge. There is no C6. On the buccal face the buccal groove is not very deep, and it ends gradually.

The minimum distance between the canine alveoli is 17.7 mm, while the distance between the midpoints of the interdental septa separating the dm<sub>1</sub> and dm<sub>2</sub> is 28.9 mm. The corpus depth is greatest near the symphysis (21.5 mm) (Supplementary Table 2). Posterior to the jugum, at the dc level, there is a single and circular mental foramen situated just below mid-corpus height. A shallow sulcus is located between the jugum/mental foramen area and the basal contour. Inferior to the dm<sub>2</sub>, a deeply concave surface marks the root of the lateral superior torus above mid-corpus height, while the surface is fairly flat below. The preserved segment of the basal margin is thin and rounded. The relatively flat anterior surface of the peri-symphyseal region shows a posteriorly retreating inferior segment. The vertical height of the ovoid symphyseal cross section (21.2 mm) is roughly twice its maximum anteroposterior dimension (11.2 mm). The post-incisive planum converges posteroinferiorly with the weakly and the developed superior transverse torus approximately 14.0 mm from the incisive alveoli, and it is noticeably longer than in KW 7000 (6.9 mm).

### **Supplementary Note 3. Maxillary and mandibular symphyseal changes associated with the principal component analyses**

The following three results are detailed separately for the configurations of landmarks and semilandmarks of the maxilla (Fig. 6b), the shape of the symphysis along the mid-sagittal plane (Fig. 7a), and the symphyseal area (Fig. 7c), using principal components (PCs):

- the statistical significance of each PCA using a randomization test,
- the landmarks or semilandmarks that contribute most to variation (i.e., that change the most) along each PC,
- the shape changes associated with each PC, as the trend from the minimum to the maximum values.

#### Maxilla (Fig. 6b,c)

The landmarks or semilandmarks that contribute most to variation (i.e., that change the most) along each bgPC are:

PC1 (28.6% of variance): The semilandmarks located along the buccal edge of the alveolar border, landmark 15 at the base of the lateral margin of the nasal aperture, the prosthion (landmark 8), and the semilandmarks 10 to 14 positioned on nasopalveolar clivus (Supplementary Figure 9);

PC3 (15.8% of variance): The semilandmarks positioned on the nasal spine (landmark 10) and the posterior part of the nasopalveolar clivus (landmarks 11 to 14), and landmark 15 located at the base of the lateral margin of the nasal aperture (Supplementary Figure 9).

The main changes associated with PC1 and PC3 are:

PC1 (28.6% of variance): Along this PC, there is an antero-inferior drift of the inferior margin of the nasal aperture (landmark 15), superior drift of the anterior dental arcade (semilandmarks 1 to 7), and anteroposterior contraction of the nasopalveolar clivus (Supplementary Figure 9);

PC3 (15.8% of variance): Along this PC, there is anterosuperior shifting of the nasal spine (semilandmark 10), and a backward shifting of the nasopalveolar clivus (semilandmarks 11 to 14) relative to the lateral margin of the nasal aperture (landmark 15) (Supplementary Figure 9). This characteristic separates DNH 83 from both *P. robustus* and *A. africanus*.

#### Mandibular symphysis along the mid-sagittal plane (Fig. 7a)

The randomization test yields a highly significant p-value ( $p < 0.001$ ), confirming the presence of differences between australopiths (*A. africanus* and *P. robustus*) and Omo 222-1973-2744 on one side, and early *Homo* (both KW 7000 and KNM-ER 820) and *H. sapiens* on the other.

The landmarks or semilandmarks that contribute most to variation (i.e., that change the most) along each PC are:

PC1 (62.1% of variance): The infradentale anterior and all the semilandmarks located on the anterior surface.

PC2 (18.8% of variance): The semilandmarks positioned on the anterior surface below mid-height and those on the posterior surface near mid-height.

The main changes associated with PC1 and PC2 are:

PC1 (62.1% of variance): Along this PC, the most negative PC1 values are characterized by a symphysis that slopes antero-inferiorly from the anterior alveolar border to the base, accompanied by an incurvatio mandibulae anterior. In contrast, the most positive values exhibit a symphysis that slopes sharply postero-inferiorly, with no incurvatio mandibulae anterior.

PC2 (18.8% of variance): Along this PC, differences are observed in the posterior symphyseal morphology and the presence or absence of a chin. At the most positive values, the mandibular symphysis is notably receding.

Mandibular symphyseal area (Fig. 7c).

The randomisation test reveals a highly significant p-value ( $p < 0.001$ ) confirming the existence of differences between australopiths (*A. africanus* and *P. robustus*) and Omo 222-1973-2744 on one side, and early *Homo* (KW 7000) and *H. sapiens* on the other.

The landmarks or semilandmarks that contribute most to variation (i.e., that change the most) along each PC are:

PC1 (60.3% of variance): on the midsagittal profile, the infradentale anterior and posterior, and close to the midline, the semilandmarks located on the anteroinferior portion of the symphysis and the posterior surface close to mid-height;

PC2 (10.2% of variance): some semilandmarks located the anteroinferior portion of the symphysis.

The main changes associated with each bgPC are:

PC1 (60.3% of variance): anteroposterior contraction of the symphysis, along with its more vertical orientation and its more convex mental surface inferiorly. These characteristics separate the australopiths (who exhibit an anteroposteriorly thicker and more inclined symphysis, with no convex mental surface inferiorly), on the one hand, from both early *Homo* and *H. sapiens*, on the other.

PC2 (10.2% of variance): anteroposterior thinning of the symphysis at its inferior portion, with no change in its inclination.

#### **Supplementary Note 4. Dental traits distinguishing Omo 222-1973-2744 and other early *Homo* specimens from *P. boisei***

Several dental traits distinguish Omo 222-1973-2744 and other early *Homo* specimens from *P. boisei*:

i) a shallow and relatively short principal buccal groove on the dm1<sup>11,21</sup>, whereas *P. boisei* specimens from both the Koobi-Fora Formation in Kenya (KNM-ER 1477)<sup>20</sup> and the Shungura Formation in Ethiopia (L 704-2)<sup>73</sup> exhibit a deep groove extending inferiorly to indent the cervical margin<sup>11,22,23</sup>;

- ii) the proportional mesio-distal length of the  $dm_1$  trigonid is longer than the talonid in early *Homo* (KNM-ER 820, KNM-ER 1507, Zhoukoudian B IV), whereas the talonid is larger than the trigonid in *P. boisei* (KNM-ER 1477 and L 704-2)<sup>11</sup>;
- iii) the metaconid cusp tip is on the same transverse plane as the protoconid in *P. boisei* (KNM-ER 1477 and L 704-2), whereas the metaconid is distally placed in respect to the protoconid in *Homo* (KNM-ER 820, KNM-ER 1507, Zhoukoudian B IV)<sup>11</sup>;
- iv) early *Homo* (KNM-ER 1507, Zhoukoudian B IV) lacks a C6, whereas KNM-ER 1477 has it<sup>32</sup> and L 704-2 has a 'minuscule accessory cuspule'<sup>23</sup>;
- v) the fovea anterior is a triangular or Y-shaped depression in early *Homo* (KNM-ER 1507 and Zhoukoudian B IV), whereas is a broad, transverse fissure in *P. boisei* (KNM-ER 1477 and L 704-2)<sup>11</sup>;
- vi) there is a small 'mesioconulid'<sup>11</sup> in early *Homo* (KNM-ER 1507 and Zhoukoudian B IV) whereas it is large in *P. boisei* (KNM-ER 1477 and L 704-2)<sup>11</sup>;
- vii) the distal trigonid crest is shallowly incised in early *Homo* (KNM-ER 1507 and Zhoukoudian B IV) whereas it is deeply incised in *P. boisei* (L 704-2)<sup>11</sup>;
- viii) a distal marginal ridge is present in *P. boisei* (KNM-ER 1477 and L 704-2) while it is absent in Omo 222-1973-2744<sup>11</sup>;
- ix) the *tuberculum molare* is well developed in early *Homo* (KNM-ER 820, KNM-ER 1507 and Zhoukoudian B IV) whereas there is no *tuberculum molare* in *P. boisei* (L 704-2)<sup>11</sup>.

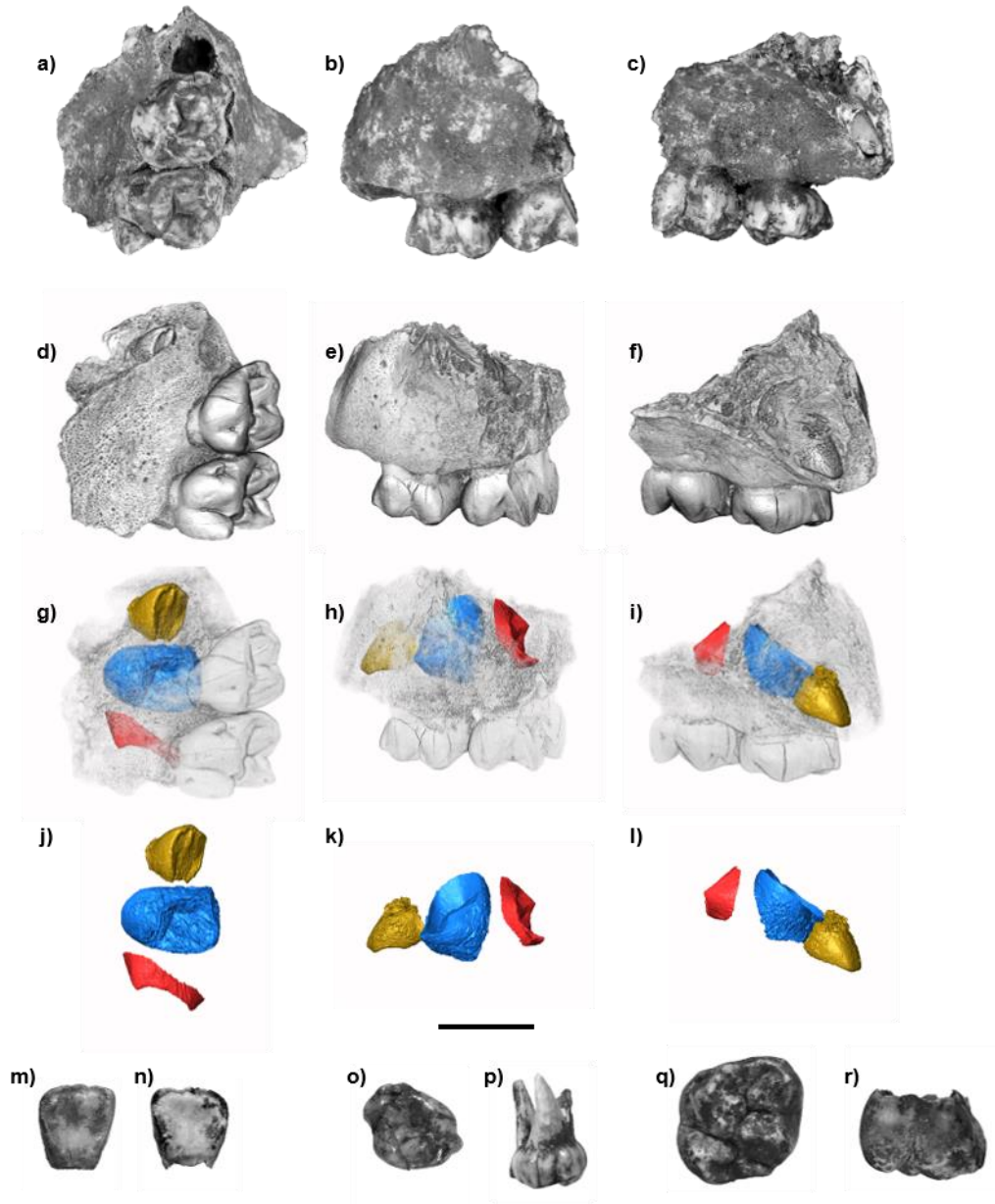
**Supplementary Table 1. Maxillary measurements.** All measurements are given in mm. APAB, anterior palatal breadth. ANMB, anterior maxillo-alveolar breadth. APB, anterior premaxilla breadth. APB, anterior premaxilla breadth. AAL, anterior alveolar length. APLP, antero-posterior length of the premaxilla. Values in parentheses are estimated for damaged specimens. L, left; R, right. Specimens are ranked based on their dental age, as in Box 1.

| Specimen | Taxon                        | Side | APAB   | ANMB   | APB    | AAL  | APLP |
|----------|------------------------------|------|--------|--------|--------|------|------|
| DNH 83   | Early <i>Homo</i>            | R    | 15.2   | 22.4   | 16.8   | 12.9 | 7.7  |
| DNH 47   | <i>Paranthropus robustus</i> | L    | (21.2) | (29.8) | 18.8   | 17.2 | 11.7 |
| DNH 84   | <i>Paranthropus robustus</i> | L    | (23.4) | (32.9) | (26.3) | -    | -    |
| KW 9000  | <i>Paranthropus robustus</i> | L    | 24.7   | 32.3   | 26.2   | 19.1 | 9.2  |

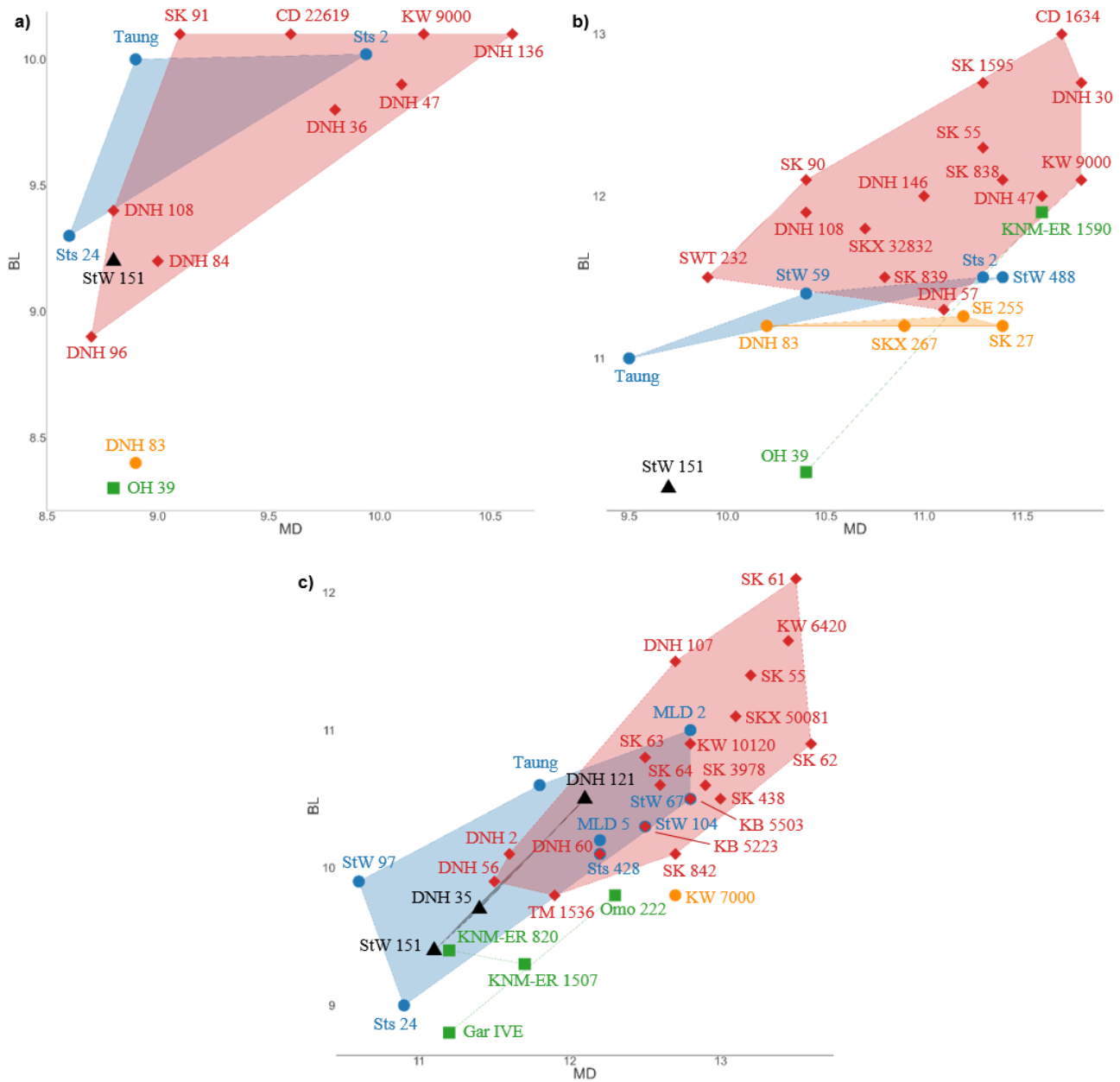
**Supplementary Table 2. Mandibular measurements.** All measurements are given in mm. SH, symphyseal height. SD, symphyseal depth (maximal value). W, width of the corpus. H, height of the corpus. ASYM, the angle between the symphyseal axis and the basal plane. BR1, the minimum chord distances between the walls of the right and left dc alveoli. BR2, the minimum chord distances between the walls of the right and left  $dm_1$  alveoli. AL1, the minimum chord distance between the infradentale and the midpoint of the alveolar septum between the  $di_2$  and dc. AL2, the minimum chord distance between the midpoint of the interalveolar septum between

the di<sub>2</sub>/dc and the posterior wall of the dm<sub>1</sub> alveolus. Values in parentheses are estimated for damaged specimens. L, left; R, right. Specimens are ranked based on their dental age, as in Box 1.

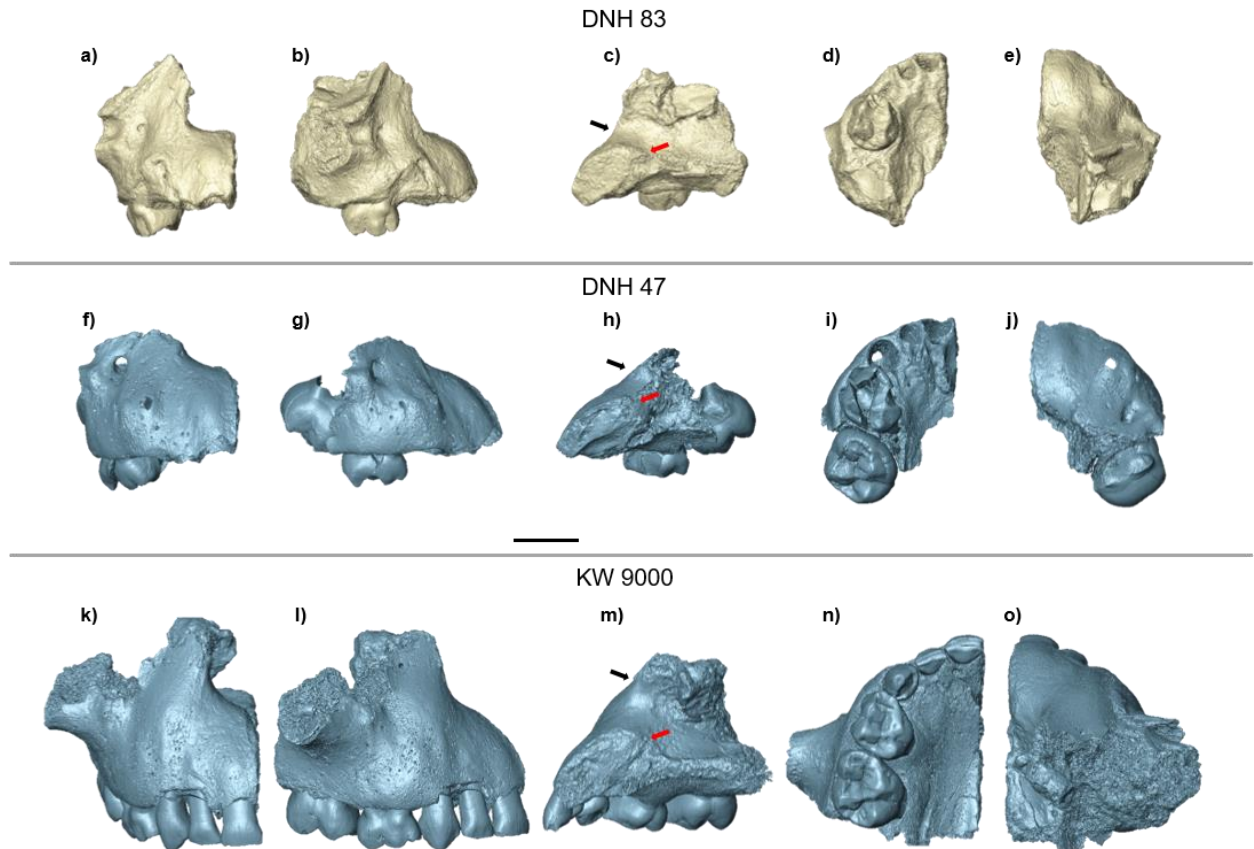
| Specimen          | Taxon                              | SH   | SD   | Wdi <sub>1</sub> | Hdi <sub>1</sub> | Wdc  | Hdc  | Wdm <sub>1</sub> | Hdm <sub>1</sub> | ASYM | BR1  | BR2  | AL1  | AL2  |
|-------------------|------------------------------------|------|------|------------------|------------------|------|------|------------------|------------------|------|------|------|------|------|
| KW 7000           | <i>Homo</i> aff. <i>H. erectus</i> | 20.9 | 10.4 | 10.6             | 19.3             | 10.4 | 17.8 | 10.1             | 18.9             | 104  | 13.0 | 17.1 | 7.3  | 15.2 |
| KW 6420           | <i>P. robustus</i>                 | 18.9 | 12.2 | 13.2             | 16.7             | 12.6 | 17.2 | 12.7             | 17.9             | 119  | 11.1 | 14.1 | 6.3  | 15.2 |
| SK 3978           | <i>P. robustus</i>                 | 25.1 | 11.7 | 11.5             | 24.0             | 12.6 | 21.7 | 13.0             | 22.5             | 110  | 12.9 | 15.9 | 7.1  | 15.1 |
| Omo 222-1973-2744 | <i>Homo habilis</i>                | 20.4 | 10.9 | 11.4             | 19.6             | 13.6 | 19.7 | 12.5             | 18.5             | 119  | 16.6 | 19.9 | 8.5  | 15.6 |
| KNM-ER 1477       | <i>P. boisei</i>                   | 22.5 | 13.0 | 13.1             | 24.0             | 15.6 | 22.3 | 16.5             | 22.0             | 109  | 15.8 | 18.6 | 9.0  | 15.2 |
| SK 62             | <i>P. robustus</i>                 | 27.3 | 18.7 | 17.1             | 26.0             | 16.7 | 25.6 | 16.9             | 25.8             | 112  | 15.7 | 19.0 | 8.7  | 15.1 |
| SK 61             | <i>P. robustus</i>                 | 32.7 | 16.0 | 15.9             | 31.9             | 16.0 | 28.2 | 17.8             | 27.6             | 113  | 16.5 | 20.0 | 8.9  | 14.6 |
| KNM-ER 1820       | <i>P. boisei</i>                   | 31.0 | 21.0 | -                | -                | -    | -    | 18.1             | 27.1             | -    | -    | -    | -    | -    |
| KNM-ER 1507       | <i>Homo</i> aff. <i>H. erectus</i> | -    | -    | -                | -                | 15.5 | 27.1 | 15.7             | 22.9             | -    | -    | -    | -    | 19.0 |
| KNM-ER 820        | <i>Homo</i> aff. <i>H. erectus</i> | 27.0 | 17.5 | 17.1             | 27.0             | 16.1 | 23.5 | 15.0             | 23.0             | 112  | 21.0 | 23.4 | 11.8 | 17.1 |
| SK 63             | <i>P. robustus</i>                 | 27.6 | 17.5 | 14.7             | 26.5             | 17.4 | 27.1 | 17.6             | 28.1             | 109  | 14.9 | 19.3 | 10.4 | 15.4 |



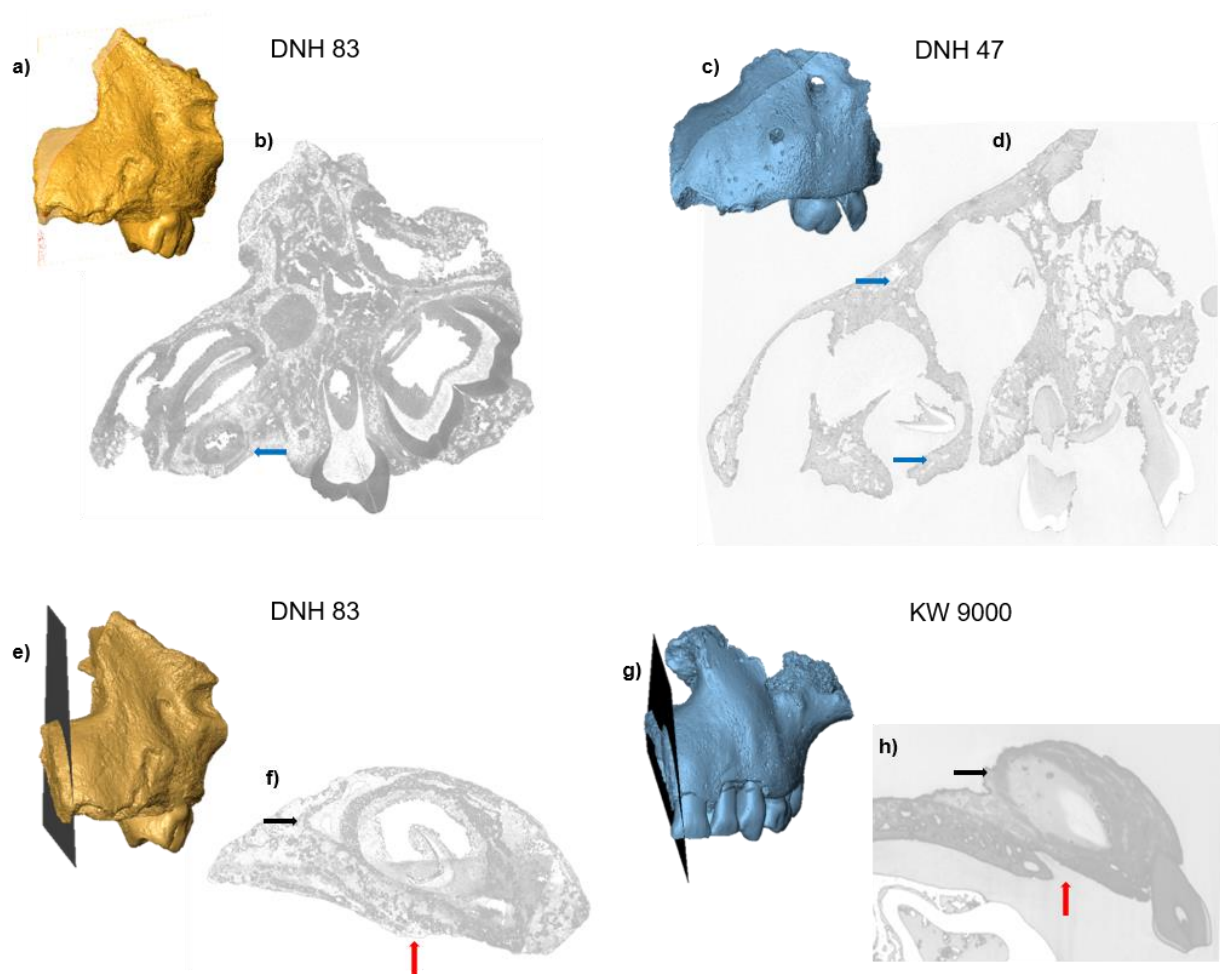
**Supplementary Figure 1. The DNH 84 left maxilla.** The specimen DNH 84 is attributed to *P. robustus*. It is shown with the  $dm^1$  and the broken  $dm^2$  in position, in (a) inferior, (b) lateral and (c) medial views. Inferior (d, g), lateral (e, h) and medial (f, i) views of 3D surface (d-f) and volume (g-i) renderings showing the specimen with the germs of its permanent canine (in gold), first (in blue) and second (in red) premolars in transparency. Inferior (j), lateral (k) and medial (l) views of the same germs as for (g, i). Left  $I^1$  (m) and Right  $I^1$  (n) in lingual views. Right  $dm^1$  in occlusal (o) and lingual (p) views. Left  $M^1$  in occlusal (q) and lingual (r) views. Scale bar, 1 cm.



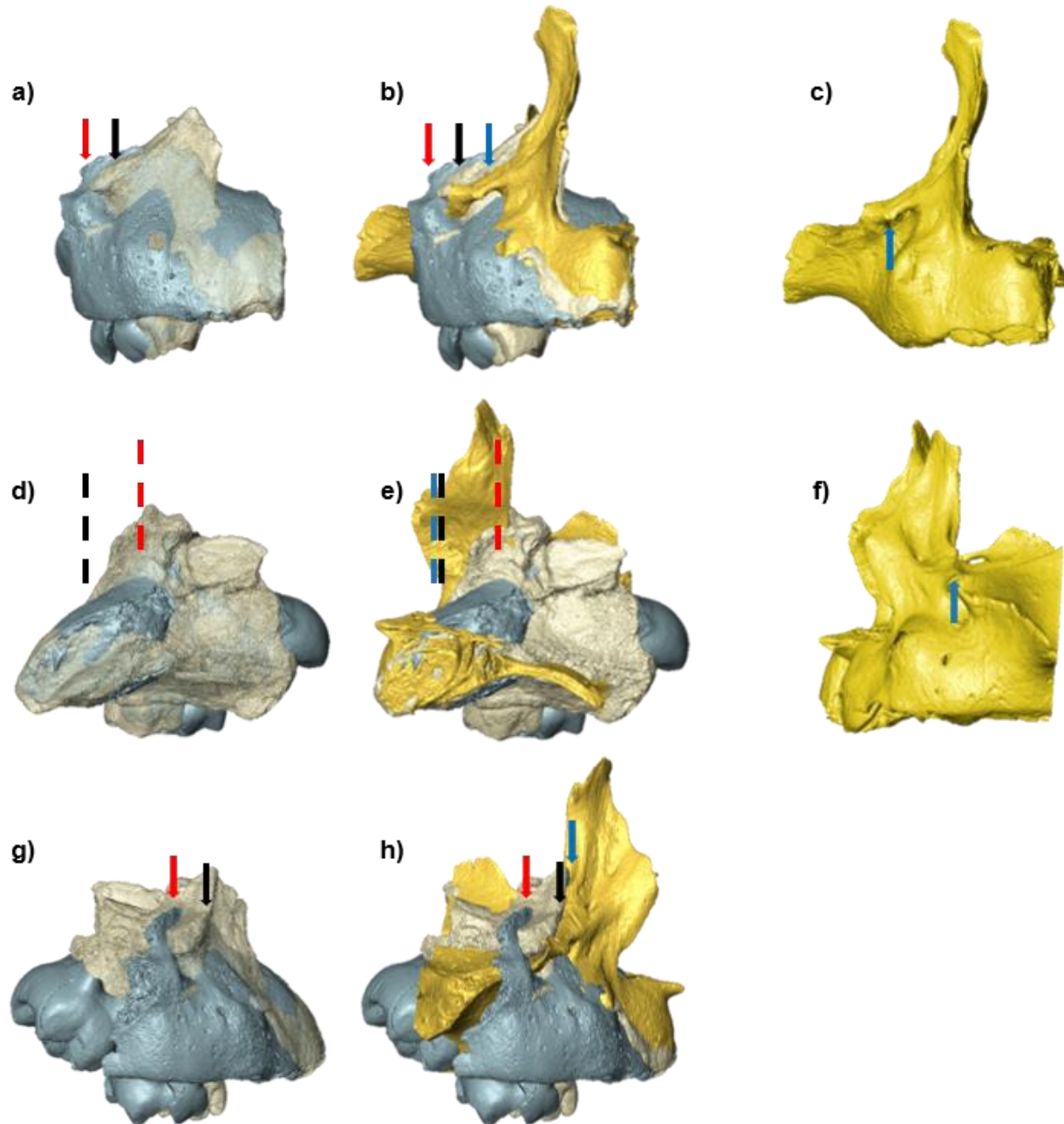
**Supplementary Figure 2. Mesio-distal and bucco-lingual diameters of early hominins from Africa.** Mesio-distal (MD) and bucco-lingual (BL) diameters are shown in mm. *A. africanus* (blue circles), *P. robustus* (red diamonds), early *Homo* from southern Africa (orange circles) and eastern Africa (green squares), disputed attribution (black triangles). a, MD and BL diameters of the dm<sup>1</sup> with DNH 83 illustrated with an orange circle. b, MD and BL diameters of the dm<sup>2</sup>. Note that Sts 24 and DNH 83 have the same measurements. c, MD and BL diameters of dm<sup>2</sup> with KW 7000 illustrated with an orange circle. Variations within taxa are represented as convex polyhedra that enclose the corresponding points.



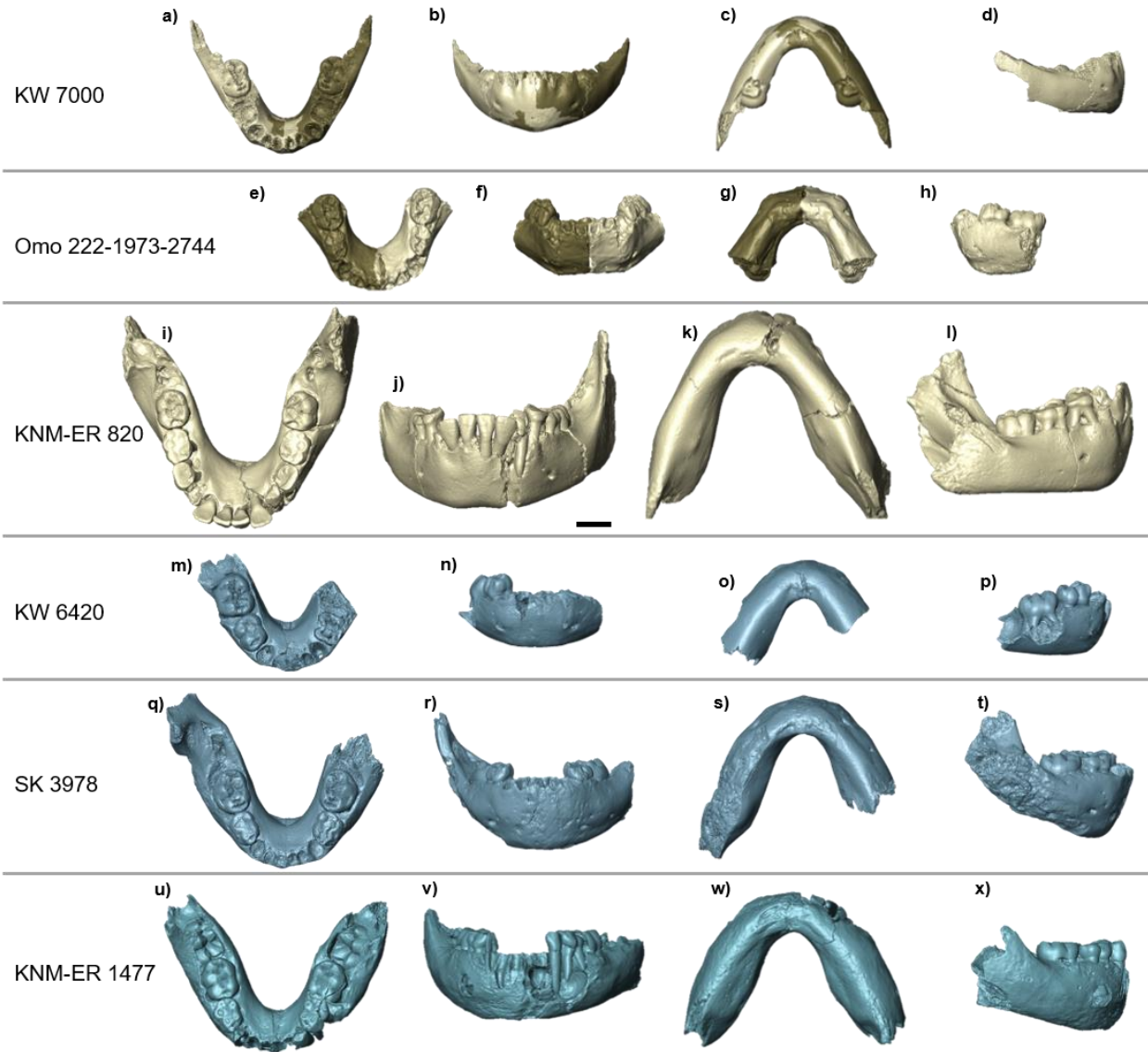
**Supplementary Figure 3. Comparisons of the maxilla between early *Homo* and *P. robustus* infants.** a-e, Renders in 3D of the DNH 83 right maxilla (in golden color) shown in (a) anterior, (b) lateral, (c) medial, (d) inferior and (e) superior views. f-j, Renders in 3D of the DNH 47 left maxilla (in blue color, mirrored to the right for ease of comparison) shown in (f) anterior, (g) lateral, (h) medial, (i) inferior and (j) superior views. k-o, Renders in 3D of the KW 9000 left maxilla (in blue color, mirrored to the right for ease of comparison) shown in (k) anterior, (l) lateral, (m) medial, (n) inferior and (o) superior views. Arrows indicate the position of the posterior pole of the nasoalveolar clivus (in red) relative to the base of the nasal aperture (in black). Scale bar, 1 cm.



**Supplementary Figure 4. Comparisons of the incisive suture and subnasal morphologies between early *Homo* and *P. robustus* infants.** a, Orientation of a synchrotron oblique slice shown on a 3D renders of the DNH 83 specimen to investigate its incisive suture. b, Same oblique slice as for (a) showing the complete closure of the anterior component of the incisive suture (blue arrow) in DNH 83. c, Orientation of a synchrotron oblique slice shown on a 3D renders of the DNH 47 specimen to investigate its incisive suture. d, Same oblique slice as for (c) showing the partial closure of the anterior component of the incisive suture (blue arrows) in DNH 47. e, Orientation of a synchrotron sagittal slice shown on a 3D renders of the DNH 83 specimen to investigate its subnasal morphology. f, Same oblique slice as for (e) showing the subnasal morphology in DNH 83. Black arrows indicate the superoposterior pole of the alveolar process. Red arrows indicate the nasal entrance to the incisive canal. g, Orientation of a micro-CT sagittal slice shown on a 3D renders of the KW 9000 specimen to investigate its subnasal morphology. h, Same oblique slice as for (g) showing the subnasal morphology in KW 9000.

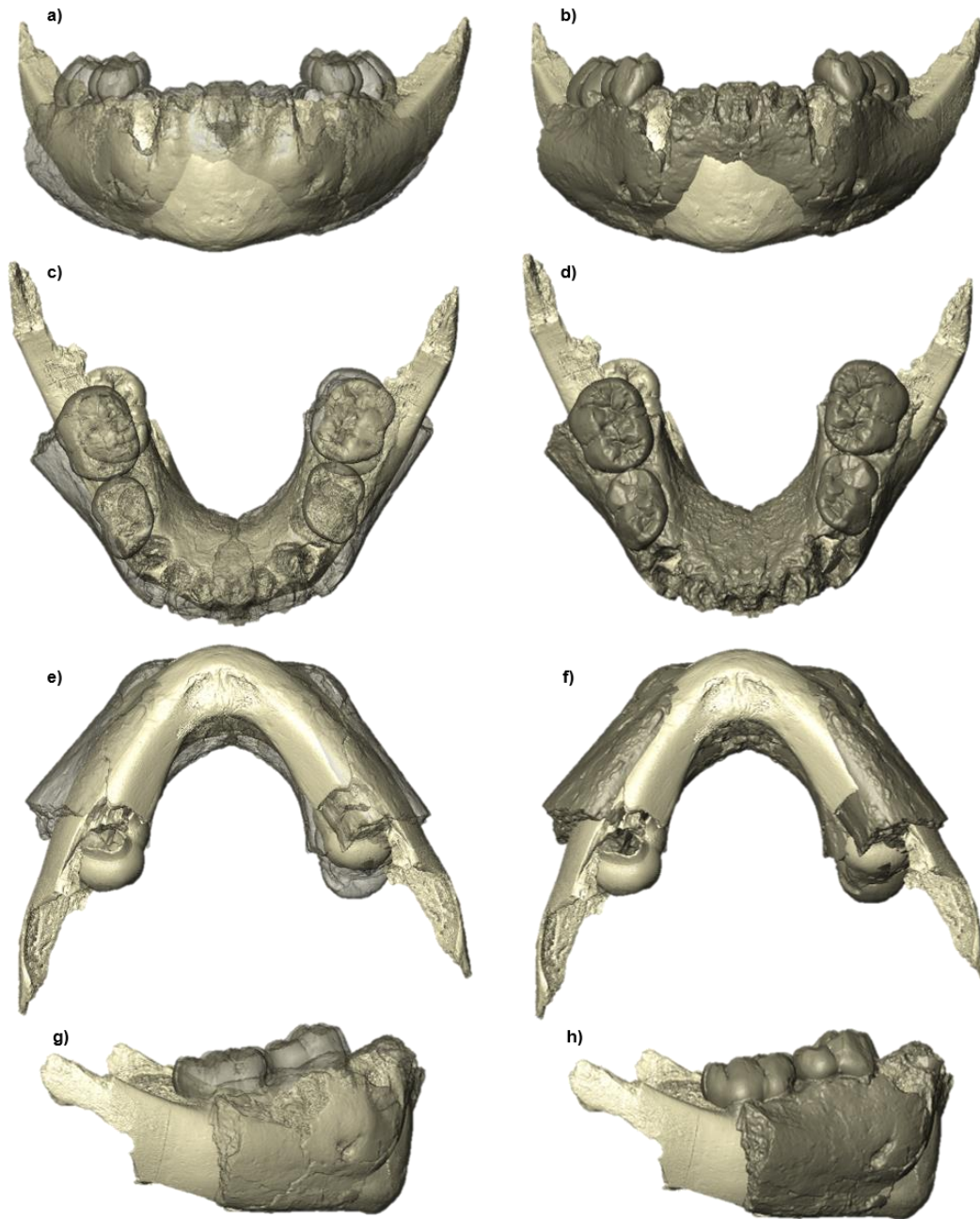


**Supplementary Figure 5. Alignments of the maxilla in early *Homo*, *P. robustus* and *H. sapiens* infants.** Renders in 3D of the maxillae (aligned without scaling) of DNH 83 (in beige color), DNH 47 (in blue color) and one nine-months old female *H. sapiens* (in yellow color). Anterior (a,b,c), medial, (d,e), left lateral (f) and right lateral (g,h) superior views. The DNH 47 left maxilla is mirrored to the right for ease of comparison. Arrows indicate the position of the inferior orbital rim in DNH 47 (in red), DNH 83 (in black) and *H. sapiens* (in blue). Dotted lines indicate the position of the base of the nasal aperture (as also indicated in Supplementary Figure 3) in DNH 47 (in red), DNH 83 (in black) and *H. sapiens* (in blue).

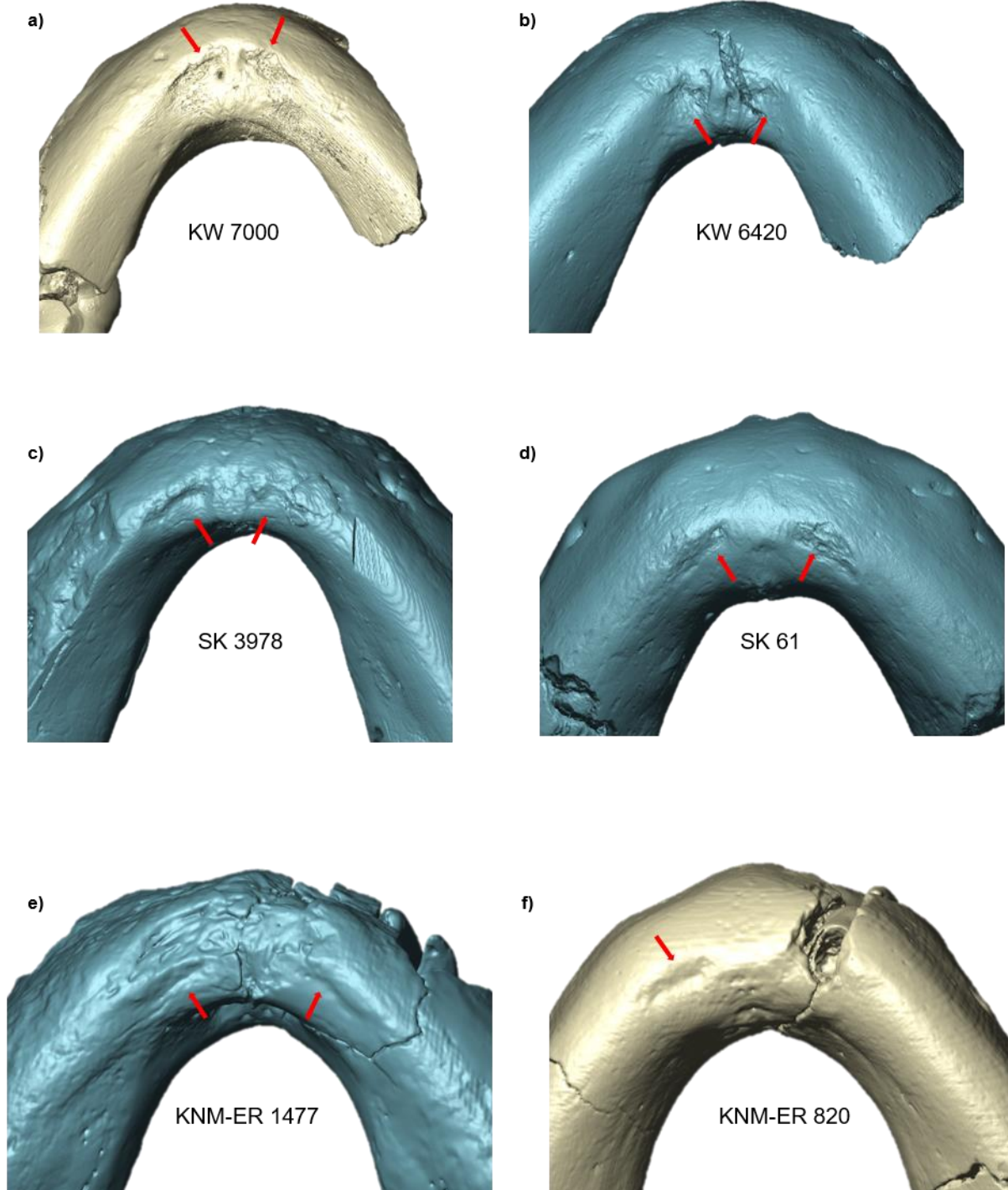


**Supplementary Figure 6. Comparisons of the mandible between early *Homo*, *P. robustus* and *P. boisei* infants.** The specimens are to scale and aligned using the same orientations. a-d, Renders in 3D of the KW 7000 early *Homo* specimen (in beige color) with the right dm2 in position, combined with its mirrored surface shown (in darker color), in superior (a), anterior (b), inferior (c) and right lateral (d) views. e-h, Renders in 3D of the Omo 222-1973-2744 *Homo habilis* specimen (in beige color), with the left dm1-2 in position, combined with its mirrored surface shown (in darker color), in superior (e), anterior (f), inferior (g) and left lateral (h) views. i-l, Renders in 3D of the KNM-ER 820 *Homo* aff. *H. erectus* specimen (in beige color) in superior (i), anterior (j), inferior (k) and right lateral (l) views. m-p, Renders in 3D of the KW 6420 *P. robustus* specimen (in blue color), with the right dm1-2 in position, in superior (m), anterior (n), inferior (o) and right lateral (p) views. q-t, Renders in 3D of the SK 3978 *P. robustus* specimen (in blue color) in superior (q), anterior (r), inferior (s) and right lateral (t)

views. u-x, Renders in 3D of the KNM-ER 1477 *P. boisei* specimen (in blue color) in superior (u), anterior (v), inferior (w) and right lateral (x) views. Scale bar, 1 cm.

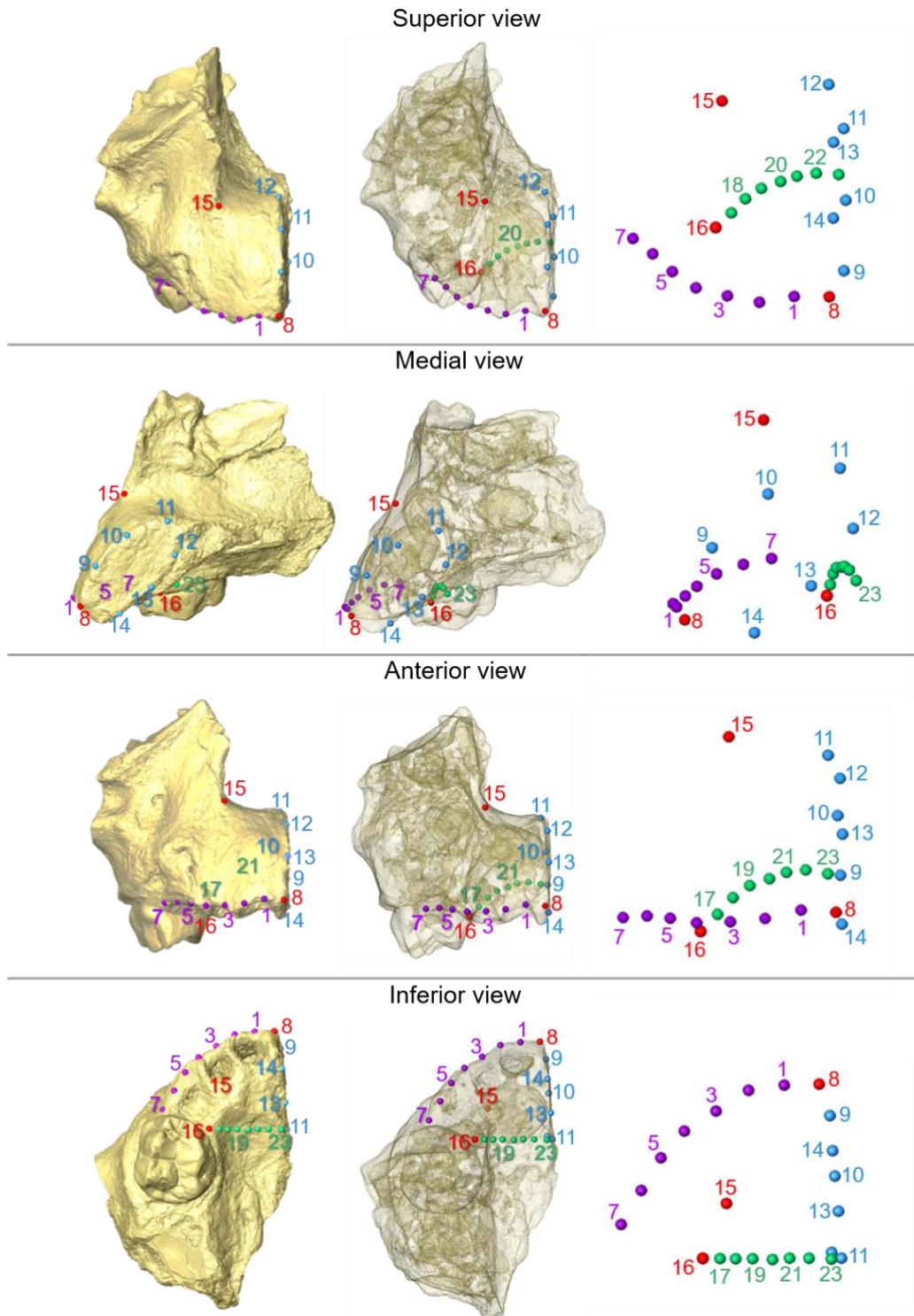


**Supplementary Figure 7. Alignments of the mandible in early *Homo infants*.** Renders in 3D of the mandibles (aligned without scaling) of KW 7000 (in beige color) and Omo 222-1973-2744 (in darker and brown color). Anterior view with (a) without (b) transparency; Superior view with (c) without (d) transparency; Inferior view with (e) without (f) transparency; Right lateral view with (g) without (h) transparency. For ease of comparison, the KW 7000 right corpus is mirrored to the left, and the Omo 222-1973-2744 left corpus is mirrored to the right.



**Supplementary Figure 8. The geniohyoid depressions in early *Homo* and *Paranthropus* juvenile specimens.** The base of the symphysis shown in inferior view in the KW 7000 early *Homo* infant (a), the KW 6420 (b), SK 3978 (c) and SK 61 (d) *P. robustus* infants (KW 6420 and SK 3978) and older juvenile (SK 61), the KNM-ER 1477 *P. boisei* infant (e, note the abrasion on

the anterior part of the inferior surface), and the KNM-ER 820 *Homo* aff. *H. erectus* juvenile (f). Red arrows indicate the position of the geniohyoid depressions.



**Supplementary Figure 9. Configuration of landmarks and semilandmarks used to compare the maxillary morphology.** Landmarks and semilandmarks are displayed in superior, medial,

anterior, and inferior views on the right maxilla, or individually (enlarged when not displayed on the maxilla). In each view, the right maxilla is also shown with a transparent overlay. The configuration is defined by 3 landmarks (in red) and 20 semilandmarks (in blue, violin and green colors) described in the Methods and numbered as follows: (i) the prosthion (landmark 8 in red) and 7 semi-landmarks (semilandmarks 1 to 7 in violin) located from medial (adjacent to the prosthion) to lateral, along the buccal edge of the alveolar border, to the septum between the deciduous canine ( $d^c$ ) and the first deciduous molar ( $dm^1$ ); (ii) the prosthion (landmark 8 in red) and 6 semilandmarks positioned along the midline contour of the nasoalveolar clivus (semilandmarks 9 to 14 in blue, clockwise); (iii) one landmark (landmark 15 in red) at the base of the lateral margin of the nasal aperture; (iv) one landmark positioned at the lingual extremity of the septum between the right  $d^c$  and  $dm^1$  (landmark 16 in red) along with 7 semi-landmarks (semilandmarks 17 to 23 in green) positioned on the hard palate from lateral to medial. These 7 semilandmarks numbered 17 to 23 lie on a vertical and transverse plane perpendicular to the alveolar border, extending to the midline.

## Supplementary References

1. Herries, A.I.R. et. al. Contemporaneity of *Australopithecus*, *Paranthropus*, and early *Homo erectus* in South Africa. *Science* **368**, eaaw7293 (2020).
2. Braga, J. et. al. in *Kromdraai, a birth place of Paranthropus in the Cradle of Humankind* (eds, J. Braga & J.F. Thackeray), 49-68 (Sun Media Metro, Johannesburg, 2016).
3. Braga, J. et al., Hominin fossils from Kromdraai and Drimolen inform *Paranthropus robustus* craniofacial ontogeny. *Sci. Adv.* **9**, eade7165 (2023).
4. Braga, J. & Grine, F.E. New craniodental fossils of *Paranthropus robustus* from Kromdraai, South Africa (2014-2017 excavations). *J. Hum. Evol.* **188**, 103481 (2024).
5. Broom, R. The Pleistocene anthropoid apes of South Africa. *Nature*, **142**, 377-379 (1938).
6. Hanon, R. et al. New fossil Bovidae (Mammalia: Artiodactyla) from Kromdraai Unit P, South Africa and their implication for biochronology and hominin palaeoecology. *Quat. Sci. Rev.* **331**, 108621 (2024).
7. Braga, J., Thackeray, F. & Zipfel B., The Kromdraai early hominin-bearing site. A review of recent findings. *L'Anthropologie* **126**, 103054 (2022).
8. Howell, F.C. & Coppens, Y. in *Earliest Man and Environments in the Lake Rudolf Basin* (eds Coppens, Y., Howell, F.C., Isaac, G.L. & Leakey R.E.F.) 522-532 (University of Chicago Press, 1976).
9. Feibel, C.S., Brown, F.H. & McDougall, I. Stratigraphic context of fossil hominids from the Omo group deposits: northern Turkana Basin, Kenya and Ethiopia. *Am. J. Phys. Anthropol.* **78**, 595-622 (1989).
10. White, T.D. in *Evolutionary History of the "Robust" Australopithecines* (Ed. F.E. Grine), 449-483 (Aldine de Gruyter, New York, 1988).
11. Grine, F.E. *The deciduous dentition of the Kalahari San, the South African negro and the South African Plio-Pleistocene hominids*, PhD thesis, University of the Witwatersrand (1984).

12. Braga, J. et al., Hominin fossils from Kromdraai and Drimolen inform *Paranthropus robustus* craniofacial ontogeny. *Sci. Adv.* **9**, eade7165 (2023).
13. Braga, J. Chimpanzee variation facilitates the interpretation of the incisive suture closure in South African Plio-Pleistocene hominids. *Am. J. Phys. Anthropol.* **105**, 121-135 (1998).
14. Rak, Y. *The australopithecine face* (Academic Press, 1983).
15. Grine, F.E. & Strait, D.S. New hominid fossils from Member 1 “hanging remnant,” Swartkrans formation, South Africa. *J. Hum. Evol.* **26**, 57-75 (1994).
16. Leece, A.B. et al. New hominin dental remains from the ~2.04–1.95 Ma Drimolen Main Quarry, South Africa. *Ann. Hum. Biol.* **50**, 407–427 (2023).
17. Johanson, D.C., White, T.D. & Coppens, Y., Dental remains from the Hadar Formation, Ethiopia: 1974-1977 collections. *Am. J. Phys. Anthropol.* **57**, 545-603. (1982).
18. Johanson, D.C., White, T.D. & Coppens, Y. A new species of the genus *Australopithecus* (Primates: Hominidae) from the Pliocene of eastern Africa. *Kirtlandia* **28**, 1–14 (1978).
19. Robinson JT. *The dentition of the Australopithecinae*. *Transvaal Mus. Mem.* **9**, 1-179 (1956).
20. B. Wood, *Koobi Fora Research Project. Volume 4: Hominid cranial remains* (Clarendon Press, 1991).
21. Moggi-Cecchi, J., Menter, C., Boccone, S. & Keyser, A. Early hominin dental remains from the Plio-Pleistocene site of Drimolen, South Africa. *J. Hum. Evol.* **58**, 374-405 (2010).
22. Hillson, S. *Dental Anthropology* (Cambridge University Press, 1996).
23. Clark Howell, F. & Coppens, Y. Deciduous teeth of Hominidae from the Pliocene/Pleistocene of the lower Omo basin, Ethiopia. *J. Hum. Evol.* **2**, 461-472 (1973).