



# DNH 109: A fragmentary hominin near-proximal ulna from Drimolen, South Africa

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## Dates:

Received: 05 Oct. 2010

Accepted: 06 Mar. 2011

Published: 12 May 2011

## How to cite this article:

Gallagher A, Menter CG. DNH 109: A fragmentary hominin near-proximal ulna from Drimolen, South Africa. *S Afr J Sci.* 2011;107(5/6), Art. #456, 4 pages. doi:10.4102/sajs.v107i5/6.456

We describe a fragmentary, yet significant, diminutive proximal ulna (DNH 109) from the Lower Pleistocene deposits of Drimolen, Republic of South Africa. On the basis of observable morphology and available comparative metrics, DNH 109 is definitively hominin and is the smallest African Plio-Pleistocene australopithecine ulna yet recovered. Mediolateral and anteroposterior dimensions of the proximal diaphysis immediately distal to the *m. brachialis* sulcus in DNH 109 yield an elliptical area ( $\pi/4 \times m-l \times a-p$ ) that is smaller than the A.L. 333-38 *Australopithecus afarensis* subadult from Hadar. Given the unusually broad mediolateral / anteroposterior diaphyseal proportions distal to the brachialis sulcus, the osseous development of the medial and lateral borders of the sulcus, and the overall size of the specimen relative to comparative infant, juvenile, subadult and adult comparative hominid ulnae (*Gorilla*, *Pan* and *Homo*), it is probable that DNH 109 samples an australopithecine of probable juvenile age at death. As a result of the fragmentary state of preservation and absence of association with taxonomically diagnostic craniodental remains, DNH 109 cannot be provisionally assigned to any particular hominin genus (*Paranthropus* or *Homo*) at present. Nonetheless, DNH 109 increases our known sample of available Plio-Pleistocene subadult early hominin postcrania.

## Introduction

The fossil hominin site of Drimolen, currently dated by faunal correlation to between 2.0 MYA and 1.5 MYA, has yielded a wealth of craniodental specimens attributed to *Paranthropus robustus* ( $n = 60$ ) and a more modest sample of early *Homo* ( $n = 9$ ).<sup>1,2,3,4</sup> Most of the *Australopithecus*, *Paranthropus* and early *Homo* hypodigms from the Cradle of Humankind consist of craniodental specimens in varying states of preservation.<sup>2,3,4,5,6,7,8,9</sup> Postcranial specimens attributed to *P. robustus* and early *Homo* are comparably rare and only three localities – Swartkrans, Kromdraai and Drimolen – have yielded postcranial specimens that are confidently assigned to these taxa.<sup>2,3,4,10,11,12,13,14</sup> Morphological and metrical affinities of available postcranial remains have generally failed to reject the hypothesis that a single locomotor ‘morph’ is represented amongst Lower Pleistocene hominins in South Africa.<sup>10,15,16,17,18,19,20,21,22,23,24</sup> We describe here a fragmentary, yet potentially important, near-proximal ulna (DNH 109) recovered from the decalcified sediments in the Main Quarry of Drimolen. DNH 109 was excavated in 1995 from grid square N199, E203 at a height of -2.00 m to -2.10 m below the Drimolen datum.

## Materials and methods

Comparative infant, juvenile and subadult samples of *Pan* (including *P. paniscus*,  $n = 53$ ), *Gorilla* ( $n = 29$ ) and *Homo* ( $n = 162$ ) and adult samples of *P. paniscus* ( $n = 15$ ), *P. t. troglodytes* ( $n = 85$ ), *G. gorilla* ( $n = 99$ ), *H. sapiens* ( $n = 118$ ) and *Papio* ( $n = 56$ ) were measured at the Cleveland Museum of Natural History (USA), Kent State University (USA), the Natural History Museum (USA), the Powell-Cotton Museum (UK), the University of Dundee (UK), the Royal Museum of Central Africa (Belgium) and the University of the Witwatersrand (SA). The human postnatal growth series comprised individuals aged 0–9 years at death, whereas the *Pan* and *Gorilla* series included individuals ranging from newborn to adolescent (prior to epiphyseal fusion). The human sample from the Raymond Dart Collection at the University of the Witwatersrand included South African individuals of European and African ancestry. Original South African fossils and high resolution casts of available East African specimens were measured in the School of Anatomical Sciences, University of the Witwatersrand. Linear dimensions of the proximal ulnar diaphysis were taken at the terminus of the *m. brachialis* sulcus<sup>25,26</sup> using Mitutoyo™ digital calipers (Mitutoyo Corporation, Aurora, IL, USA), accurate to the nearest 0.01 mm. Additional published data for A.L. 438-1, KNM-BK 66, KNM-ER 803, KNM-WT 15000, KRM and Skhul/Qafzeh were used in the analysis.<sup>26,27</sup>

## Preservation and morphology of DNH 109

### Preservation

DNH 109 is a near-proximal portion of a right diaphysis which is broken distal to the coronoid process (Figure 1). No proximal articulation is preserved. The specimen is missing the olecranon,



FIGURE 1: DNH 109 in *norma verticalis* (a) and *norma medialis* (b).

trochlear notch, radial notch and coronoid process. The shaft fragment at its greatest length is 52.6 mm. The break at the proximal end of the specimen is just below the anterior border of the coronoid process. Inferior to this the ulnar tuberosity and a very small supinator crest are preserved. The ulnar tuberosity is missing a 1-cm long, narrow flake of bone that would form the proximomedial border of the rim of the ulnar tuberosity. There are several hairline cracks running longitudinally through the ulnar tuberosity. The medial rim of the ulnar tuberosity displays a number of small grooves that run from the medial edge onto the posterolateral surface of the shaft, possibly evidence of taphonomic damage by a carnivore 'worrying' the bone. Some small tooth scores are evident. On the anterior surface of the bone just proximal to the distal break a nutrient foramen is evident. Whilst the supinator crest is evident, it is abraded over most of its length.

### Morphology

As no proximal articulation is preserved there is little morphology that can be discussed, which makes the taxonomic attribution of this specimen problematic. DNH 109 is both smaller and less robust than the smallest accepted adult Plio-Pleistocene ulna, A.L. 288-1. The ulnar tuberosity or area for attachment of *m. brachialis* is well-defined, proximodistally elongate and forms an ovoid depression reminiscent of the *A. afarensis* subadult specimen, A.L. 333-98. The medial (anterior border) and lateral margins

of the ulnar tuberosity are less well developed than in A.L. 288-1. The nutrient foramen in DNH 109 lies inferior to the terminus of the brachialis sulcus and is slightly medial to the lateral border, as in the A.L. 288-1n,t (*A. afarensis*) paired left and right ulnae. The only linear dimensions that can be measured on DNH 109 include the mediolateral and anteroposterior dimensions of the distal margin of the ulnar tuberosity. The linear dimensions of DNH 109 and its calculated elliptical area are at the lower size range of the available Plio-Pleistocene specimens, particularly with respect to the anteroposterior depth (Table 1). Although the supinator crest is slightly abraded, it is clear that it is very weakly expressed; in relation to the fossil hominin sample, it is one of the more weakly expressed supinator crests. The lack of development of the supinator crest suggests that the specimen is a subadult individual. In distal view the shaft is triangular in cross section.

### Taxonomic status and age at death

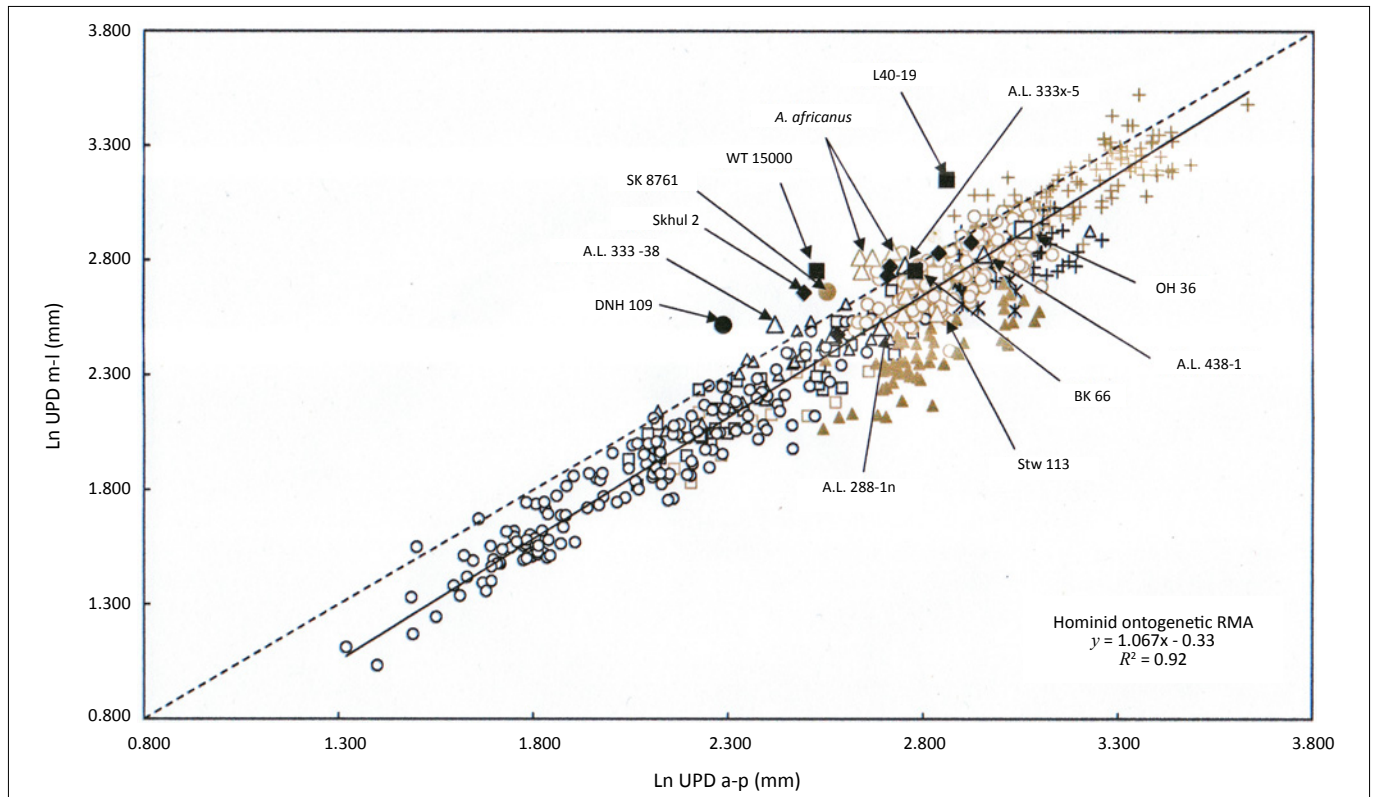
The proximal diaphyseal proportions of DNH 109 are consistent with a taxonomic allocation to the Hominini tribe. The majority of Plio-Pleistocene hominin (*Australopithecus* and early *Homo*) ulnae contrast with *Pan*, *Gorilla* and more recent humans (ontogenetic and adult,  $n = 561$ ) in their broad mediolateral proximal diaphysis relative to the anteroposterior depth at the terminus of the brachialis sulcus<sup>25,26,27,28,29,30,31,32</sup> (Figure 2), and this proportion is accentuated in certain individuals, including DNH 109, assigned to *Australopithecus*, *Paranthropus*, and *Homo*. The mediolateral/anteroposterior proportions of DNH 109 are almost equivalent to other Plio-Pleistocene African australopiths, yet the anteroposterior diameter in DNH 109 is absolutely small. Whilst DNH 109 is similar to East African early *Homo* (Omo L-40-19, KNM-WT 15000) with respect to its extreme mediolateral/anteroposterior proportions (Table 1 and Figure 2), it also approaches A.L. 333-38, a putative subadult *A. afarensis* proximal ulna from Hadar.<sup>32</sup> Stw 113 from Sterkfontein Member 4 (STM 4) falls at the lower extremes of the *A. africanus* distribution by virtue of its narrow mediolateral/anteroposterior proximal diaphyseal proportions (Table 1 and Figure 2), yet clusters with Stw 431, Stw 108, and Stw 390. The mediolateral/anteroposterior proportions of proximal ulnar diaphyses of African late Pliocene australopiths and Lower, Middle and early Upper Pleistocene *Homo* show considerable variation, within and between genera (A.L. 288-1, Figure 2). As such, no obvious conclusions can be drawn as to the precise taxonomic affinities of DNH 109. The extreme diminution of DNH 109 relative to comparative infant and juvenile hominid ulnae (including *P. paniscus*) and representative Plio-Pleistocene hominin comparatives (including A.L. 333-38) is consistent with an inference of probable late juvenile or early adolescent age at death.

### Conclusion

DNH 109 is definitively hominin and likely represents one of the youngest (ontogenetically) available Plio-Pleistocene hominin ulnae. The absolute small size of DNH 109 is

**TABLE 1:** Linear dimensions (mm) of Plio-Pleistocene hominins in comparison to DNH 109.

| Specimen      | Sex    | Taxon               | Ulna proximal diaphysis |                 |                 | Mediolateral/anteroposterior |
|---------------|--------|---------------------|-------------------------|-----------------|-----------------|------------------------------|
|               |        |                     | Mediolateral            | Anteroposterior | Elliptical area |                              |
| A.L. 288-1n   | Female | <i>A. afarensis</i> | 12.30                   | 14.76           | 11.94           | 0.833                        |
| A.L. 288-1t   | Female | <i>A. afarensis</i> | 11.91                   | 13.06           | 11.05           | 0.912                        |
| A.L. 333-38   | ?      | <i>A. afarensis</i> | 12.68                   | 11.24           | 10.58           | 1.128                        |
| A.L. 333-x5   | Male   | <i>A. afarensis</i> | 16.10                   | 15.69           | 14.09           | 1.026                        |
| A.L. 438-1    | Male   | <i>A. afarensis</i> | 16.90                   | 19.20           | 15.96           | 0.880                        |
| DNH 109       | Female | Hom. gen. sp. indet | 12.42                   | 9.84            | 9.80            | 1.262                        |
| SKX 8761      | Male   | <i>P. robustus</i>  | 14.41                   | 12.71           | 11.99           | 1.134                        |
| Stw 431       | Male   | <i>A. africanus</i> | 14.15                   | 15.76           | 13.23           | 0.898                        |
| Stw 349       | ?      | <i>A. africanus</i> | 15.75                   | 14.07           | 13.19           | 1.119                        |
| Stw 568       | ?      | <i>A. africanus</i> | 17.16                   | 15.25           | 14.34           | 1.125                        |
| Stw 571       | Female | <i>A. africanus</i> | 16.73                   | 14.00           | 13.56           | 1.195                        |
| Stw 390       | ?      | <i>A. africanus</i> | 13.10                   | 15.63           | 12.68           | 0.838                        |
| Stw 380       | Male   | <i>A. africanus</i> | 16.71                   | 14.46           | 13.78           | 1.156                        |
| Stw 113       | Male   | <i>A. africanus</i> | 13.12                   | 17.07           | 13.26           | 0.769                        |
| Stw 108       | ?      | <i>A. africanus</i> | 15.16                   | 15.87           | 13.75           | 0.955                        |
| OH 36         | Male   | <i>P. boisei</i>    | 19.09                   | 21.26           | 17.85           | 0.898                        |
| Omo L40-19    | Male   | <i>Homo</i> sp.     | 23.22                   | 17.45           | 17.84           | 1.331                        |
| KNM-ER 803    | Male   | <i>Homo</i> sp.     | 15.70                   | 16.10           | 14.09           | 0.975                        |
| KNM-WT 15000  | Male   | <i>Homo</i> sp.     | 15.70                   | 12.50           | 12.42           | 1.256                        |
| KNM-BK 66     | Male   | <i>Homo</i> sp.     | 15.50                   | 17.00           | 14.39           | 0.912                        |
| Klasies River | Male   | <i>H. sapiens</i>   | 15.40                   | 15.00           | 13.47           | 1.027                        |
| Qafzeh 9      | Female | <i>H. sapiens</i>   | 17.80                   | 18.60           | 16.13           | 0.957                        |
| Skhul 2       | Female | <i>H. sapiens</i>   | 14.30                   | 12.10           | 11.66           | 1.182                        |
| Skhul 4       | Male   | <i>H. sapiens</i>   | 17.00                   | 17.10           | 15.11           | 0.994                        |
| Skhul 5       | Male   | <i>H. sapiens</i>   | 16.00                   | 15.10           | 13.78           | 1.060                        |
| Skhul 7       | Female | <i>H. sapiens</i>   | 11.90                   | 13.20           | 11.11           | 0.902                        |



Open black circles, *Homo sapiens* (0–9 years); open black squares, *Pan troglodytes* (infants and juveniles); open grey squares, *P. paniscus* (infants and juveniles); open black triangles, *Gorilla gorilla* (infants and juveniles); open grey circles, *H. sapiens* (adults); black crosses, *P. troglodytes* (adults); black asterisks, *P. paniscus* (adults); grey crosses, *G. gorilla* (adults); closed grey triangles, *Papio* sp. (adults); black diamonds, Skhul/Qafzeh (Skhul 2 is labelled).

Individual fossil specimens and hypodigmms are labelled.

The dashed line represents theoretical isometry.

**FIGURE 2:** Mediolateral diameter of the ulna proximal diaphysis (UPD m-l) relative to the anteroposterior diameter of the ulna proximal diaphysis (UPD a-p). Both dimensions were taken at the terminus of the brachialis crest (ulnar tuberosity).





primarily a function of the extremely shallow anteroposterior depth of the proximal diaphysis at the terminus of the *m. brachialis* crest. DNH 109 is a potentially important new hominin specimen from Drimolen whose size and proportions may have significance in interpreting the locomotor adaptations of associated craniodental and postcranial juvenile specimens such as DIK-1-1 (*A. afarensis*) and MH 1 (*A. sediba*) for which accurate dental developmental age at death estimates are available.<sup>33,34</sup>

## Acknowledgements

We thank D. Smith and J. Smith, on whose property Drimolen is situated, for permission to conduct the excavation and for their continued assistance. Dr J. Hailie-Selassie and L. Jellema (Cleveland Museum of Natural History), Dr C.O. Lovejoy (Kent State University) and Mr M. Harman (Powell-Cotton Museum) provided access to specimens in their care. Original South African fossils were studied at the University of the Witwatersrand and the Northern Flagship Institute. Dr B. Zipfel and Ms S. Potze kindly facilitated the measurement of specimens in their care. The Drimolen excavation is supported by grants to CGM from the National Research Foundation (NRF African Origin Platform, grant number 65155 and a SA-Italy Cooperation agreement, grant number 65155) and the Leakey Foundation. AG is supported by an NRF/University of Johannesburg Postdoctoral Research Fellowship. Financial assistance was also provided by the Ford Foundation and the Faculty of Health Sciences, University of the Witwatersrand.

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