



Peer Community In Paleontology

A new method for measuring clavicular curvature

Nuria Garcia based on peer reviews by 2 anonymous reviewers

Catherine E. Taylor, Fidelis Masao, Jackson K. Njau, Agustino Venance Songita, Leslea J. Hlusko (2023) OH 89: A newly described ~1.8-million-year-old hominid clavicle from Olduvai Gorge. bioRxiv, ver. 6, peer-reviewed and recommended by Peer Community in Paleontology. <https://doi.org/10.1101/2023.02.02.526656>

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The evolution of the hominid clavicle has not been studied in depth by paleoanthropologists given its high morphological variability and the scarcity of complete diagnosable specimens. A nearly complete *Nacholapithecus* clavicle from Kenya (Senut et al. 2004) together with a fragment from *Ardipithecus* from the Afar region of Ethiopia (Lovejoy et al. 2009) complete our knowledge of the Miocene record. The *Australopithecus* collection of clavicles from Eastern and South African Plio-Pleistocene sites is slightly more abundant but mostly represented by fragmentary specimens. The number of fossil clavicles increases for the genus *Homo* from more recent sites and thus our potential knowledge about the shoulder evolution.

In their new contribution, Taylor et al. (2023) present a detailed analysis of OH 89, a ~1.8-million-year-old partial hominin clavicle recovered from Olduvai Gorge (Tanzania). The work goes over previous studies which included clavicles found in the hominid fossil record. The text is accompanied by useful tables of data and a series of excellent photographs. It is a great opportunity to learn its role in the evolution of the hominid shoulder gird as clavicles are relatively poorly preserved in the fossil record compared to other long bones. The study compares the specimen OH 89 with five other hominid clavicles and a sample of 25 modern clavicles, 30 *Gorilla*, 31 *Pan* and 7 *Papio*. The authors propose a new methodology for measuring clavicular curvature using measurements of sternal and acromial curvature, from which an overall curvature measurement is calculated. The study of OH 89 provides good evidence about the hominid who lived 1.8 million years ago in the Olduvai Gorge region. This time period is especially relevant because it can help to understand the morphological changes that occurred between *Australopithecus* and the appearance of *Homo*. The authors conclude that OH 89 is the largest of the hominid clavicles included in the analysis. Although they are not able to assign this partial element to species level, this clavicle from Olduvai is at the larger end of the variation observed in *Homo sapiens* and show similarities to modern humans, especially when analysing the estimated sinusoidal

curvature.

References:

Lovejoy, C. O., Suwa, G., Simpson, S. W., Matternes, J. H., and White, T. D. (2009). The Great Divides: *Ardipithecus ramidus* reveals the postcrania of our last common ancestors with African apes. *Science*, 326(5949), 73–106. <https://doi.org/10.1126/science.1175833>

Senut, B., Nakatsukasa, M., Kunimatsu, Y., Nakano, Y., Takano, T., Tsujikawa, H., Shimizu, D., Kagaya, M., and Ishida, H. (2004). Preliminary analysis of *Nacholapithecus* scapula and clavicle from Nachola, Kenya. *Primates*, 45(2), 97–104. <https://doi.org/10.1007/s10329-003-0073-5>

Taylor, C., Masao, F., Njau, J. K., Songita, A. V., and Hlusko, L. J. (2023). OH 89: A newly described 1.8-million-year-old hominid clavicle from Olduvai Gorge. *bioRxiv*, 526656, ver. 6 peer-reviewed by PCI Paleo. <https://doi.org/10.1101/2023.02.02.526656>

Reviews

Evaluation round #1

DOI or URL of the preprint: <https://doi.org/10.1101/2023.02.02.526656>

Version of the preprint: 4

Authors' reply, 16 August 2023

Dear Recommender,

Thank you for your time, patience, and feedback on this manuscript. We have revised the manuscript to incorporate the reviewer comments and believe that the manuscript is stronger than the original submission. Importantly, we have also removed a portion of our modern human comparative sample from the analysis. The individuals removed from the data set are all Native California modern humans housed at the Hearst Museum at the University of California, Berkeley. Although we had permission to collect these data and use them for publication when the data were collected in 2017 and 2018, we decided to remove these data from the sample both for ethical reasons and in light of UC Berkeley's changing policies on using human remains in research.

In addition to removing the Native California individuals, we have added more detail to the methodology section as requested by reviewers to better illustrate our methods in measuring clavicular curvature. We have also provided more details on how maximum length of OH 89 was calculated. The estimated length of the partial clavicle changed minorly due to the removal of a portion of the modern human comparative sample. We have also added a bit more discussion of the utility of PCA and t-SNE analyses, and how the two bring unique insights to analyses.

Due to the removal of some of the human comparative samples from the data set, some statistics and numbers have changed minorly since the original submission. However, analyses reveal largely the same conclusions as they did with the larger data set. Although OH 89 now sits on the very edge of our human sample instead of well within it, the conclusions are essentially the same and have been modified in the manuscript to reflect this change in sample size.

Thank you for your feedback on this manuscript and for making it a better paper.

Cat Taylor, PhD

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Decision by Nuria Garcia, posted 13 April 2023, validated 13 April 2023

OH 89: A newly described ~1.8-million-year-old hominid clavicle from Olduvai Gorge

The manuscript entitled OH 89: A newly described ~1.8-million-year-old hominid clavicle from Olduvai Gorge, has been reviewed by two experts in the field, who found the manuscript contains important information suitable for publication. However, both have found a lack of clarity in the methodology applied.

The two reviewers have suggested a better explanation of the methodology such as how to measure the curvature, calculate the radius, locate the center...

With the revised text, considering each of the referees' suggestions/comments, the manuscript would be suitable to be recommended.

Reviewed by anonymous reviewer 1, 04 April 2023

This paper presents a detailed analysis of OH89, a partial hominid clavicle recovered from Olduvai Gorge (Tanzania) with a chronology of 1.8-million-year-old. The work is well-informed by previous studies and quite careful. My main concern about the manuscript is related to the methodology to quantify clavicle curvatures presented in this study. The authors proposed a new method based on four steps. In the third step, they claimed that "two circles were overlain on each clavicle, one on the sternal and one on the acromial curve, such that the circle touches both endpoints of each curve and the maximum height of the curve". Looking at the figure, I cannot understand well as the endpoints of each curve are estimated. I propose that the authors explain better this point in order to this method will be repeatable in future works.

Reviewed by anonymous reviewer 2, 27 March 2023

This manuscript presents a great opportunity to discover a new hominin clavicle from Olduvai Gorge that is dated back to 1.8 million years ago, along with a new methodology to calculate the curvature of a fragmentary specimen. The text is accompanied by useful tables of data and a series of excellent photographs.

However, there are a few things I would like to mention. Firstly, I think that the new methodology on how to measure the curvature could be explained better. How do you draw the circumferences? How do you locate the center? And how do you calculate the radius? It is a basic mathematical problem, but it would be helpful if you could explain it in more detail.

Secondly, in the Materials and Methods section, although you reference it, it would be helpful to provide the regression formulae and parameters to calculate the maximum length. If you have your own data (Figure 5 and tables 1 and 2), maybe you could build your own formulae?

Thirdly, you mentioned that t-SNE is a technique for visualizing high-dimensional data in two dimensions, somewhat similar to PCA but with the capability of collapsing multidimensional data into a two-dimensional visualization. I thank you for showing me this new tool. However, if you can collapse this multivariate set of measurements into only two, and you show only two PCs in your graphs, why did you do the PCA? Is it saying the same thing as t-SNE?

Lastly, if I understood correctly, in the discussion, you spent some time explaining the goodness of your method versus PCA. Maybe you could emphasize this more from the beginning of the paper