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Commentary on Neves et al. (2024): Dental metrics of *Sahelanthropus* and other hominoids

Significance:

Neves et al. (S Afr J Sci. 2024;120(7/8), Art. #16362) have presented a valuable dental database for a diversity of hominoids, which can be criticised for two reasons. Firstly, they make a taxonomic statement based only on a size-related first principal component. Secondly, they regard the second principal component as insignificant. Thus, they conclude on weak grounds that their results do not "preclude" *Sahelanthropus* from being a hominin. I used UPGMA (unweighted pair group method with arithmetic mean) analysis to infer that variability in upper dentition molars of the hominoid taxa under consideration is not inconsistent with the view that *Sahelanthropus* is a hominin.

Introduction

Neves et al.[1] have undertaken an interesting "first of its kind" multivariate analysis of mesiodistal (MD) and buccolingual (BL) measurements of teeth of a diversity of hominoids (hominins and apes), including *Sahelanthropus,* circa 7 million years old from Chad as reported by Brunet et al.[2] From principal component (PC) analysis they conclude that their results are not inconsistent with the view that taxonomically *Sahelanthropus* is a hominin rather than an ape. Their conclusion is based on the first component (PC1) which they correctly recognise as being associated with size; but size alone is certainly not necessarily a reflection of taxonomic relationships. Secondly, they dismiss PC2 as having no relevance in their analysis. They explicitly state: "PC2 is residual in nature and does not allow for any interpretation."[1] However, this is not necessarily the case, as the second component is typically related to shape, associated with morphology, even if the amount of variance associated with PC2 (or PC3) is relatively low.

These observations do not in any way diminish the value of their basic data set and the results of their PC analysis. What matters is the way in which the data are interpreted. In their graph upon which Figure 1 is based, PC2 values for *Sahelanthropus,* early *Homo* and *Pan* (chimpanzees) all fall within a limited range of about +1.5 to -1.5. Contrary to the view of Neves et al.[1] who stated that PC2 "does not allow for any interpretation", there is indeed significance in the sense that *Paranthropus* shows the greatest degree of variability in the first and second principal components.

MD/BL ratios independent of size

Recognising that size is strongly associated with PC1 which accounts for most of the variability of the multivariate analysis, it is appropriate to examine MD/BL ratios which are independent of size. Table 1 shows such ratios for upper first, second and third molars for nine hominoid taxa. These data are based only on mean MD/BL values published by Neves et al.[1] such that, as yet, it is not possible to demonstrate ranges of variation. Unfortunately, from the results available based on mean values (Table 1), independent of size, it is not possible to identify distinct taxonomic groups.

UPGMA analysis

The results of an UPGMA (unweighted pair group method with arithmetic mean) analysis of the MD and BL measurements published by Neves et al.[1] for upper post-canine dentition are presented in Figure 2. Three groups

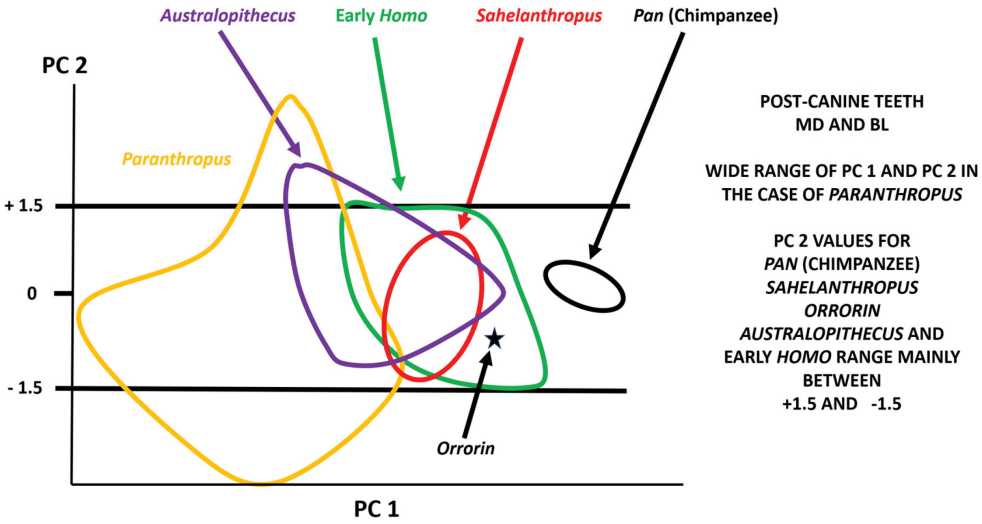

Figure 1: Results of a principal component (PC) analysis of mesiodistal (MD) and buccolingual (BL) measurements of upper post-canine teeth, based on the study by Neves et al.[1]

Table 1: Mesiodistal (MD) and buccolingual (BL) ratios for first (M1), second (M2) and third (M3) upper molars for nine hominoid taxa, based on data published by Neves et al.[1]

Hominoid taxon	MD/BL ratios		
	M1	M2	M3
Sahelanthropus	0.945	0.996	0.889
Orrorin	0.873	0.833	0.798
Australopithecus afarensis	0.882	0.897	0.818
A. africanus	0.940	0.904	0.856
Homo habilis	0.946	0.873	0.864
H. erectus	0.928	0.902	0.824
Paranthropus robustus	0.881	0.879	0.879
P. boisei	0.912	0.869	0.842
Pan troglodytes male	0.948	0.881	0.845
Pan troglodytes female	0.947	0.886	0.851

are recognised. The *y*-axis reflects UPGMA distance on a scale not related to time.

The three groups based on UPGMA are shown schematically in Figure 3 with reference to relative dates for genera under consideration. Group 1 includes South African *Australopithecus* as well as East African and South African *Paranthropus.* Group 2 includes East African *Australopithecus,* East African early *Homo, Orrorin* and *Sahelanthropus.* Group 3 includes *Pan.* A conclusion which can be drawn is that *Sahelanthropus* relates more closely to *Orrorin* and later East African hominins, than it does to *Pan*.

Conclusion

Neves et al.[1] have presented a valuable database for MD and BL measurements for upper post-canine dentition of a diversity of hominoids, but they can be criticised for two reasons. Firstly, they make a taxonomic statement based only on a size-related PC1. Secondly, they regard PC2 as insignificant. Thus, they conclude on weak grounds that their results do not "preclude" *Sahelanthropus* from being a hominin. Based on an UPGMA, it can be inferred that the variability in upper post-canine dentition of the taxa under consideration is not inconsistent with the view that *Sahelanthropus* is a hominin (Figure 3).

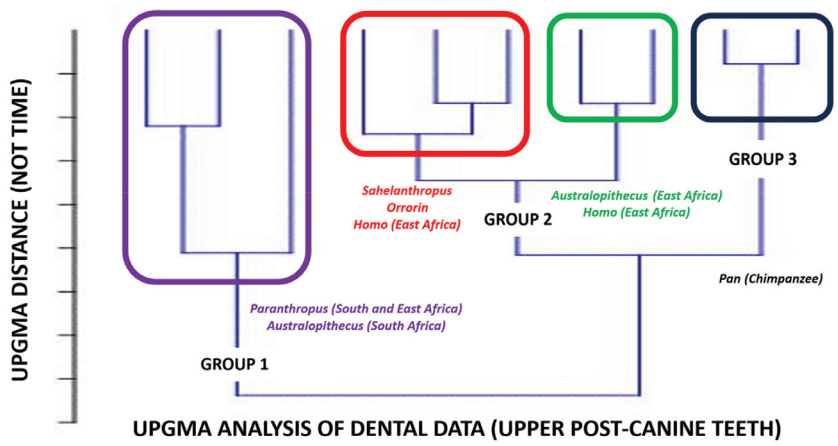

Figure 2: UPGMA (unweighted pair group method with arithmetic mean) analysis of mesiodistal and buccolingual measurements obtained from upper post-canine dentition, based on data published by Neves et al.[1] Three groups are recognised. The *y*-axis reflects UPGMA distance on a relative scale not related to time.

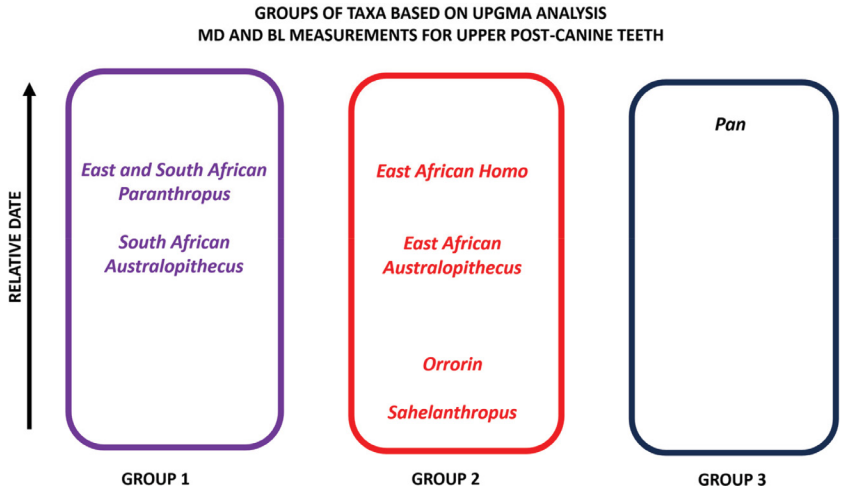

Figure 3: Simplified results of UPGMA (unweighted pair group method with arithmetic mean) analysis of mediodistal (MD) and buccolingual (BL) measurements of upper molar post-canine teeth, based on data published by Neves et al.[1] Three groups are identified. The taxa within each group are shown in the context of relative dates.

Acknowledgements

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Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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