News and Views

The stem catarrhine Saadanius does not inform the timing of the origin of crown catarrhines

Luca Pozzi*, Jason A. Hodgson, Andrew S. Burrell, Todd R. Disotell

Center for the Study of Human Origins, Department of Anthropology, New York University, 25 Waverly Place, New York, NY 10003, USA

A recent study, Zalmout et al. (2010) describe a new Oligocene primate from Saudi Arabia, which they claim provides new insights into the time of divergence between apes and Old World monkeys. The newly described fossil, named Saadanius hijazensis and dated to ~29 Ma, is inferred to be a stem catarrhine, closely related to living apes and Old World monkeys (crown Catarrhini). According to the authors, this finding indicates an origin for crown Catarrhini after 29 Ma. Here, we argue that this conclusion is unwarranted because stem fossils do not logically provide any temporal information about crown groups.

Zalmout et al. (2010) show that Saadanius shares derived features with living catarrhines, specifically a tubular ectotympanic, and also shares primitive traits with stem catarrhines (primates related to, but not within, the lineage containing all living catarrhines, e.g., Aegyptopithecus). Based on this, the authors conclude that Saadanius is a stem catarrhine very closely related to living catarrhines (although their cladistic analyses presented in the supplementary material show the Pliopithecoidea to be more closely related to living catarrhines). The authors then claim that this finding “provides new evidence consistent with a divergence date” between hominoids and cercopithecoids “after 29–28 Myr ago” (Zalmout et al. 2010, 363).

Zalmout et al. assume that the presence at 29 Ma of a closely related stem taxon such as Saadanius indicates that the divergence date of the crown group must be younger. However, it is now widely recognized that the fossil record is only able to provide hard minimum boundaries on divergence times (Benton and Donoghue, 2007; Donoghue and Benton, 2009; Ho and Phillips, 2009; Steiper and Young, 2008). That is, only the oldest known fossils bearing derived characters diagnostic of a clade can be taken as evidence of the presence of that clade at that time. These fossils therefore provide a “hard minimum bound” to the age of the clade and can be used to infer the dates of evolutionary divergences. For example, unlike all other living primates, cercopithecoids have bilophodont molars. The presence of this derived trait in the fossil Victoriapithecus, which first appears 19 Ma, allows us to classify it as a stem cercopithecoid (Benefit and McCrossin, 2002; Pilbeam and Walker, 1968). It logically follows that the divergence between cercopithecoids and their nearest living relatives (hominoids) must have occurred prior to 19 Ma.

However, while hard minimum bounds for divergence dates can be supported by fossil evidence, hard maximum bounds — the oldest inferred time for the divergence of two lineages — cannot. This is because a maximum bound implies the absence of a lineage prior to that time, but “the absence of evidence typically does not provide sufficient evidence of absence” (Ho and Phillips, 2009, pp. 370). The presence of stem fossils does not indicate that the crown group has yet to appear. In fact, it is possible that stem taxa can persist long after the appearance of the crown group. For example,
the stem catarrhine pliopithecoids persist for perhaps 15–20 Ma after the first appearance of crown fossils (Begun, 2002) as shown in Zalmout et al.’s figure 4. Therefore, stem fossils provide no information about the divergence time of a crown group.

Only a direct ancestor-descendent relationship (anagenesis) between Saadanius and the common ancestor of living catarrhines would logically justify the use of this fossil as a hard maximum bound for the divergence between hominoids and cercopithecoids. Only if Saadanius is the actual ancestor of both hominoids and cercopithecoids would it necessitate these groups diverging sometime after 29 Ma (Fig. 1a, scenario A). On the other hand, if Saadanius represents a side branch sister to crown catarrhines (cladogenesis), as reported in their cladogenesis, as reported in their

Figure 1. The diagram shows four possible scenarios describing the relationship between Saadanius and crown catarrhines (apes and Old World monkeys (OWM)): A) anagenesis; B–D) arbitrary cladogenesis scenarios. For each scenario the range of possible crown catarrhine divergence times are given. The minimum bound is set by the first appearance of a crown catarrhine in the fossil record (Ramapithecus), while the upper bound is set by the time of divergence between Saadanius and the lineage leading to the crown group. It is not possible to determine this divergence time from the fossil record; consequently the various scenarios cannot be distinguished.

References


Acknowledgments

We are grateful to Terry Harrison for advice throughout the preparation of this article. We also thank the editor, Richard Kay and an anonymous reviewer for helpful comments and suggestions.