

Comment on “A Southern Tyrant Reptile”

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Benson *et al.* (Brevia, 26 March 2010, p. 1613) reported on an Australian tyrannosauroid, represented by a pubis from the late Early Cretaceous of Victoria. However, our examination of this specimen reveals that the critical character used for this referral is not present. We contend that the bone likely belongs to a currently recognized group of Australian theropod or another group not currently known.

Benson *et al.* (1) reported the presence of “a southern tyrant reptile”—the first tyrannosauroid theropod dinosaur from Gondwana. This finding, based on an isolated pair of fused pubic bones [National Museum of Victoria (NMV) P186046] from the Early Cretaceous of Victoria, southeastern Australia, has profound implications for tyrannosauroid evolution and paleobiogeography. According to Benson *et al.*, a combination of character states of the right pubis (2) indicates not only placement within Tyrannosauroidae but also a close relationship with Tyrannosauridae specifically. This family of large, hypercarnivorous theropods includes such taxa as *Tyrannosaurus* and *Albertosaurus* and is otherwise known only from the Late Cretaceous of the northern hemisphere.

Central to Benson *et al.*'s (1) assignment of NMV P186046 is their identification of a tubercle, which, although they claim to be broken, they say once formed a “prominent, anterolaterally curving, flangelike morphology” on the proximal extremity of the pubis (i.e., the iliac peduncle) (Fig. 1A). Benson *et al.* (1) consider this morphology diagnostic of tyrannosaurids and dromaeosaurids following previous studies (3, 4). According to Benson *et al.* [figure 1B in (1)], a shadowed groove on NMV P186046 represents the broken base of the pubic tubercle. When present in theropods, the pubic tubercle forms a discrete structure that projects anteriorly to anterolaterally from the iliac peduncle (3, 4). This is exemplified in tyrannosaurids and dromaeosaurids, where the tubercle forms a prominent rugose anterolateral projection (3–5). The tubercle is therefore distinct from the anteriorly directed expansion of the iliac peduncle, which, typically in tetanurans, extends between the proximal pubic shaft and the iliac facet [figure S1 in (1)] (6, 7).

Benson *et al.* [figure S1F in (1)] further used “flangelike” to differentiate the tubercle morphology of tyrannosaurids from the “moundlike” morphology of non-tyrannosaurids. Additionally, according to Benson *et al.*, rugosity on the lateral

surface of the iliac peduncle in tyrannosaurids is also coincident with the presence of a pubic tubercle. Benson *et al.* claim that the presence of such rugosity on NMV P186046 confirms the possession of a prominent tubercle before breakage [figures 1B and S1E in (1)]. However, neither the presence of this rugosity nor a “flangelike” to “moundlike” tubercle morphology have been used as character states in any cladistic analysis of which we are aware.

Three character states of the pubic boot were identified by Benson *et al.* (1) in NMV P186046: a narrowly transverse, parallel-sided pubic boot; an anteroposteriorly large pubic boot; and a lengthy anterior expansion of the pubic boot. A narrowly transverse, parallel-sided pubic boot is considered a coelurosaurian synapomorphy (8), as Benson *et al.* (1) indicate. A large pubic boot is widely distributed among neotetanurans, as is alluded to by Benson *et al.* From their estimate of boot-to-shaft ratio in NMV P186046, Benson *et al.* (1) indicate comparable proportions to that of tyrannosauroids, some basal coelurosaurs, and some non-coelurosaurian neotetanurans, such as *Aerosteon*. Within Tyrannosauroidae, the lengthy

anterior expansion of the pubic boot in NMV P186046 is considered by Benson *et al.* (1) to be uniquely shared with tyrannosaurids. Outside Tyrannosauroidae, the trait also occurs in some ornithomimosaurids and oviraptorosaurs. Benson *et al.* (1) consider the purportedly tyrannosaurid-like pubic tubercle, lack of specific dromaeosaurid-like pubic characters, and unique combination of pubic character states possessed by NMV P186046 as clearly indicative of close tyrannosaurid affinities within Tyrannosauroidae.

Our firsthand examination of NMV P186046 indicates that the anteroproximal portion of the iliac peduncle is incomplete, as indicated by the exposure of internal trabecular bone (Fig. 1). We provide a reconstructed outline of the complete iliac peduncle (Fig. 1A) based on typical tetanuran morphology [figure S1, F to P, in (1)]. The preserved anterolateral edge of the iliac peduncle in NMV P186046 is linear, and there is no indication of a tubercle projecting anteriorly to this edge or laterally from the essentially planar lateral surface of the peduncle. Thus, contrary to Benson *et al.* (1), we find no conclusive evidence of discrete tubercle development in NMV P186046. Fractured surface bone is evident posterior to the anterolateral edge (Fig. 1, A and B). Reconstruction of these broken fragments to form an anterolaterally prominent tubercle, as suggested by Benson *et al.* (1), is speculative. Additionally, we failed to identify any rugosity on NMV P186046 in the region identified by Benson *et al.* [figures 1B and S1E in (1)]. To the contrary, this area consists of smooth surface bone and further proximally, partially exposed trabecular bone (Fig. 1A).

The lack of a prominent anterolaterally curving pubic tubercle on NMV P186046 undermines Benson *et al.*'s (1) argument that the specimen

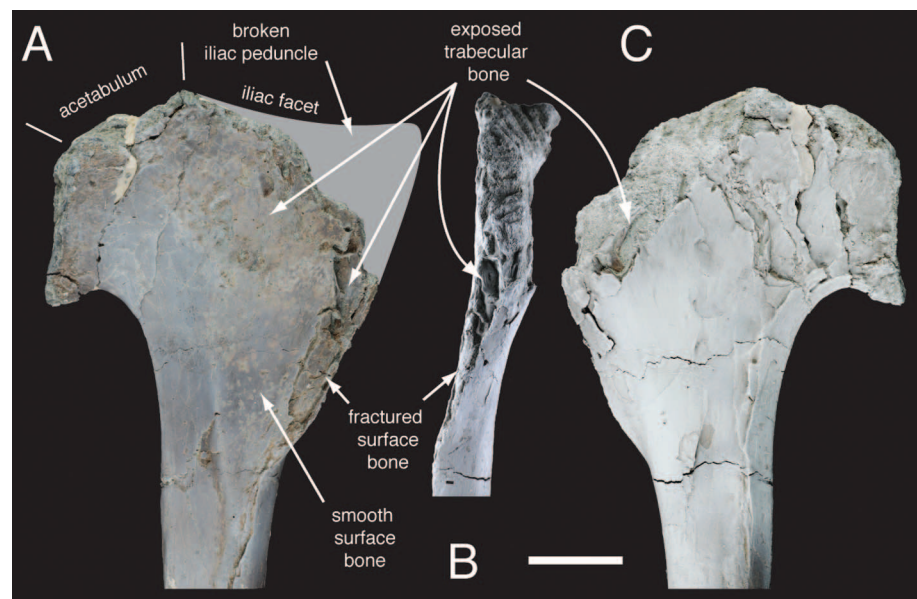


Fig. 1. Neotetanurae indet. (NMV P186046), proximal portion of the right pubis in lateral (A), anterior (B), and medial (C) views. The shaded area in (A) shows the reconstructed outline of the complete iliac peduncle based on typical tetanuran morphology. Scale bar, 10 mm. Images courtesy of Museum Victoria.

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belongs to a taxon that is closely related to tyrannosaurids. Given the presence of a transversely narrow pubic boot (8), we accept the possibility that NMV P186046 is referable to Coelurosauria (I); however, as we are uncertain of the degree of bone loss from the ventral pubic boot [in agreement with Benson *et al.* (I) that the pubic boot is broken], we only tentatively acknowledge this referral. Furthermore, the broader distribution among neotetanurans of the other pubic boot traits identified in NMV P186046 (I) indicates that a more inclusive neotetanuran placement would be more parsimonious.

Despite more than 100 years of collecting, there is no record of tyrannosauroids on any of the other southern continents. Recent reassessments of Australia's nonavian Cretaceous dinosaurs indicate affinities with faunas from other Gondwanan landmasses (9, 10). Currently recognized Australian Cretaceous theropods include carcharodontosaurians (9, 11) and paravian coelurosaurians (9), with both clades occurring in the Aptian-Albian

assemblages of southern Victoria from which NMV P186046 derives. Rather than representing an aberrant occurrence of an otherwise exclusively Laurasian theropod clade, we believe it is more likely that NMV P186046 belongs to one of the aforementioned, typically Gondwanan, theropod clades, or another as yet unrecognized neotetanuran taxon. Although the occurrence of tyrannosauroids on the southern continents during the Early Cretaceous would not be incompatible with their evolutionary history (12), we consider the referral of NMV P186046 to Neotetanurae indet. to be more consistent with its preserved anatomy.

References and Notes

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2. NMV P186046 is preserved in three parts: an almost complete right pubic body and shaft, a partial left pubis, and a fused pubic boot. NMV P186046 is incorrectly labeled in figure 1A of (I) as "NMV P186069" (an ornithopod tooth).

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