

## NOTA PALEONTOLÓGICA

# A new specimen of *Patagonykus puertai* (Theropoda: Alvarezsauridae) from the Late Cretaceous of Patagonia

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## Introduction

With their short and robust forelimbs, highly kinetic skulls, and a host of unique skeletal features, alvarezsaurids are highly specialized Mesozoic coelurosaurian theropods known from the Late Cretaceous of Asia, North, and South America (Chiappe *et al.*, 2002). Despite abundant and well-preserved material from the Gobi Desert of Mongolia, the phylogenetic relationships of alvarezsaurids have remained unclear (Chiappe *et al.*, 2002; Novas and Pol, 2002; Suzuki *et al.*, 2002). The most basal alvarezsaurids are from South America and are limited to just two taxa from the Patagonian province of Neuquén (Argentina), *Alvarezsaurus calvoi* (Bonaparte, 1991) and *Patagonykus puertai* (Novas, 1997a), which although poorly represented are important because they have been consistently interpreted as the most plesiomorphic members of the group (Novas, 1996; Chiappe *et al.*, 1998).

Here we report on a second specimen of *Patagonykus*, which we assign to the species *P. puertai* from the Late Cretaceous of Neuquén Province, Argentina. Although known from just a single manual digit, this specimen provides new information regarding the peculiar alvarezsaurid hand, and thus helps us towards a better understanding of the phylogenetic relationships of the group.

**Abbreviations:** MCF-PVPH, Museo Carmen Funes, Paleontología de Vertebrados, Plaza Huincul, Neuquén, Argentina; MPD, Mongolian Paleontological Center, Ulaanbaatar, Mongolia.

## Systematic paleontology

THEROPODA

COELUROSAURIA

ALVAREZSAURIDAE Bonaparte, 1991

**Genus** *Patagonykus* Novas, 1997a

*Patagonykus* sp. cf. *P. puertai* Novas, 1997a  
Figures 1 and 2

**Material.** MCF-PVPH-102 (Museo Carmen Funes, Paleontología de Vertebrados; Plaza Huincul, Neuquén, Argentina), an articulated phalanx 1 and 2 (ungual) of the left manual digit I.

**Geographical provenance and geological horizon.**

Northern shore of Los Barriales lake, approximately 80 km north Plaza Huincul. Because the specimen was not collected by professionals, no precise stratigraphic information is available; nonetheless, only the Late Cretaceous Neuquén Group outcrops in this area. Also, considering that the holotype specimen of *Patagonykus puertai* was found in beds attributed to the Portezuelo Member of Río Neuquén Formation (Novas, 1997a), we provisionally referred the precedence of MCF-PVPH-102 to that unit. Although absolute dating of age is not currently available, this formation has been regarded as Turonian (Novas, 1997b).

**Description.** Phalanx 1 of MCF-PVPH-102 is almost complete, missing only a portion of the lateral, hook-like ventroproximal process described for *Patagonykus puertai* (Novas, 1997a (figure 1). Only the proximal half of phalanx 2 is preserved (figure 2).

MCF-PVPH-102 is close in size to the holotype of *Patagonykus puertai* (MCF-PVPH-37), although clearly more robust. In dorsal view, major differences include the shape and depth of the extensor fossa of phalanx 2, that is placed proximal to the distal end (figure 1.B). This element is deeper and more subcircular than the corresponding subtriangular fossa of the holotype (figure 1.A). The subcircular and subtri-

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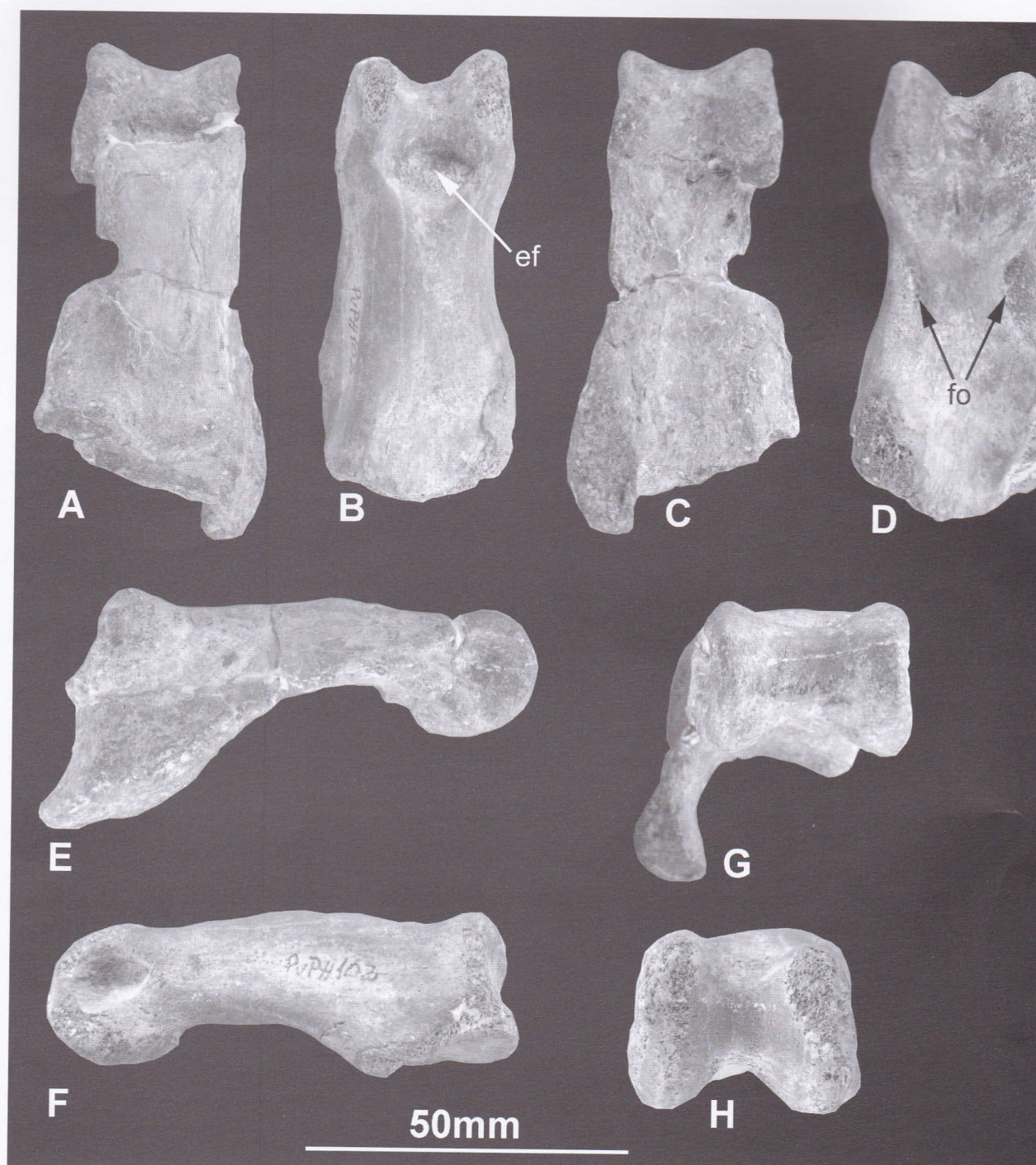


Figure 1. *Patagonykus puertai*, holotype MCF-PVPH-37, and *Patagonykus* cf. *P. puertai* MCF-PVPH-102. Proximal phalanx of digit 1 in dorsal (A, B), ventral (C, D), right lateral (E), left lateral (F), and distal (G, H) views. Figures A, C, E, and G correspond to MCF-PVPH-37. Figures B, D, F, and H, correspond to MCF-PVPH-102. Abbreviations: ef, extensor fossa; fo, ventral foramina. / *Patagonykus puertai*, holotype MCF-PVPH-37, y *Patagonykus* cf. *P. puertai* MCF-PVPH-102. Falange proximal del dígito 1 en vista dorsal (A, B), ventral (C, D), lateral derecha (E), lateral izquierda (F), y distal (G, H). Las figuras A, C, E, y G corresponden a MCF-PVPH-37. Las figuras B, D, F, y H, corresponden a MCF-PVPH-102. Abreviaturas: ef, fosa extensora; fo, forámenes ventrales.

angular outlines of these surfaces parallel those of the flexor fossae seen in both MCF-PVPH-102 and MCF-PVPH-37. Proximal to the flexor fossa, in ventral view, phalanx 2 of MCF-PVPH-102 bears a pair of deep foramina approaching the margins of the phalanx (figure 1.D). These foramina are more proximally located than the only (medial) foramen that can be

distinguished in MCF-PVPH-37 (figure 1C). The distal ginglymus of MCF-PVPH-102 is dorsoventrally higher than that of MCF-PVPH-37, a condition that renders the ginglymus of the new specimen more quadrangular than the rectangular outline of the holotype (figure 1.H-G).

The proximal articular surface of the ungual phalanx



lanx of MCF-PVPH-102 matches the quadrangular outline of the first phalanx and bears well-developed facets. Dorsal and ventral mid-projections oppose the articular surface (figure 2.C). Deep lateral grooves emarginate the sides of this phalanx and open ventrally into distinct notches (figure 2.A), whose topologic relationships are comparable to the pair of ventral foramina present in the alvarezsaurids *Mononykus olecranus* (Perle *et al.*, 1994) and *Shuvuuia deserti* (MPD 100/120) from the Late Cretaceous of the Gobi Desert (Mongolia). Just proximal to each of these notches, prominent upturned tubercles project sideways from the ventral margin of the claw (figure 2.B). Ventroproximally and across the surface between the latter ventral notches, the ungual phalanx of MCF-PVPH-102 is essentially flat. Distal to these notches, the ventral surface of the ungual phalanx bears a short, central ridge that defines oval depressions laterally (figure 2.B). A similar configuration is present in the only known manual ungual phalanx of *Alvarezsaurus calvoi* (Novas, 1996). Although we consider this ridge and its adjacent depressions (which likely served as the attachment of the powerful flexor ligaments of manual digit I) homologous with the flexor tubercle of other dinosaurian manual claws, this keeled morphology is nevertheless unique to *Alvarezsaurus calvoi* and *Patagonykus puertai*. Distal to this central ridge, the ventral surface of the claw is transversely convex, with a distinct 8-shaped cross-section that constriction is formed by the lateral grooves. Such a morphology closely resembles what can be seen in the small fragment of the ungual phalanx of the first digit of the holotype of *Patagonykus puertai*.

## Discussion

Although MCF-PVPH-102 does exhibit some differences with respect to MCF-PVPH-37, we have referred this new specimen to *Patagonykus puertai* because of the quantitative nature of observed differences and because of the lack of information regarding morphological variation within alvarezsaurid species (including sexual dimorphism).

Despite its fragmentary nature, MCF-PVPH-102 does contribute anatomical information allowing for the assessment of a number of other character states. For example, the presence of a central keel in the proximoventral surface of the ungual of manual digit I of MCF-PVPH-102 demonstrates that this condition is shared by both *Alvarezsaurus calvoi* and *Patagonykus puertai*, thus casting doubts on the autapomorphic status of this condition as proposed by Novas (1997) for *Alvarezsaurus calvoi*. Although this derived character state has not yet been included in any cladistic analysis, it is likely to represent the ple-

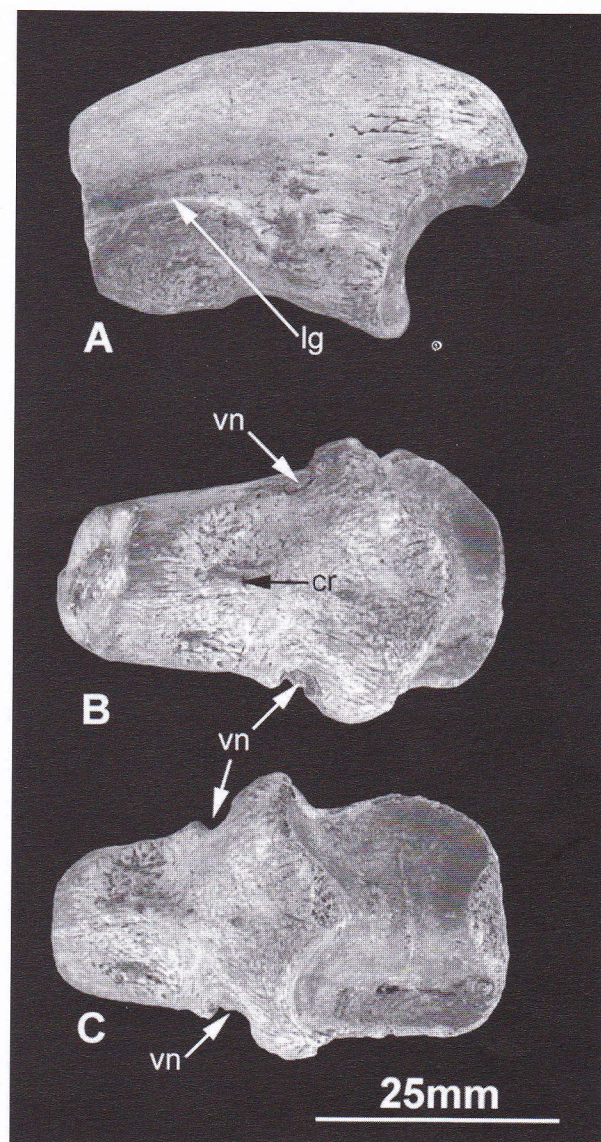


Figure 2. *Patagonykus* cf. *P. puertai*, MCF-PVPH-102. Ungual phalanx of digit I in left lateral (A), ventral (B), and ventroproximal (C) views. Abbreviations: cr, median crest; lg, lateral groove; vn, ventroproximal notch. *Patagonykus* cf. *P. puertai*, MCF-PVPH-102. Falange ungual del dígito I en vista lateral izquierda (A), ventral (B), y ventroproximal (C). Abreviaturas: cr, cresta medial; lg, surco lateral; vn, escotadura ventroproximal.

siomorphic condition for basal alvarezsaurids (and hence an alvarezsaurid synapomorphy) rather than a synapomorphy of a clade formed by these two basal taxa. The latter hypothesis would require the independent origin of several derived character states that have been proposed to unite all alvarezsaurids other than *Alvarezsaurus* (Novas, 1997a; Chiappe *et al.*, 1998). One of these synapomorphies appears to be the presence of a pair of notches or foramina on the proximoventral surface of the ungual of manual digit I, a condition previously known for *Mononykus olecranus* and *Shuvuuia deserti* and now documented for *Patagonykus* (MCF-PVPH-102).

The new specimen also sheds light on character



states previously used by Sereno (1999, 2001) to support a sister-group relationship between alvarezsaurids and ornithomimid coelurosaurians. One of these synapomorphies involves the ventral surface of the unguals. At the time of Sereno's publication, information on alvarezsaurid manual unguals was limited to digit I. A more recently described specimen of *Shuvuuia deserti* Chiappe *et al.* provides the only available information on the ungual phalanges of digits II and III of the alvarezsaurid hand (Suzuki *et al.*, 2002). Sereno (1999, 2001) proposed the presence of flattened and broad ventral surfaces of the manual unguals, as opposed to the plesiomorphic condition of these surfaces being narrow and rounded, as a synapomorphy of alvarezsaurids and ornithomimids. However, and as pointed out by Suzuki *et al.* (2002), this character state should be restricted to manual digit I since the new specimen of *Shuvuuia deserti* shows the condition of the ungual phalanges of digits II and III to be plesiomorphic. Further, MCF-PVPH-102 shows that while the ungual phalanx of manual digit I of more advanced alvarezsaurids (*Shuvuuia deserti* and *Mononykus olecranus*) have broad and flattened surfaces, that of the more basal *Patagonykus puertai* approaches more the plesiomorphic condition, an observation also suggested by the more fragmentary claw of the holotype specimen. MCF-PVPH-102 also casts some doubt on the validity of another synapomorphy proposed by Sereno (1999) to support an alvarezsaurid-ornithomimid relationship. This considers the distal displacement of the flexor tubercle of the manual phalanges to be the derived character state shared by these two clades. The area for the attachment of the flexor ligaments, however, is poorly developed (*i.e.*, weakly projected ventrally) in the ungual phalanges of the alvarezsaurid hand (Novas, 1997a; Suzuki *et al.*, 2002), in contrast with the bulbous and much better developed flexor tubercles of ornithomimids. The morphology of MCF-PVPH-102 confirms that the flexor ligaments of the unguals of digit I of basal alvarezsaurids are attached to low keels flanked by deep depressions. Further, these areas are not as distally displaced as the flexor tubercles of the ungual phalanges of ornithomimids, which are often emplaced at the mid-point of the claw.

The phylogenetic relationships of alvarezsaurids to other theropods continue to be controversial. Discoveries of fossils representing basal alvarezsaurids, such as MCF-PVPH-102, may provide the necessary information to clarify the historical relationships of the group.

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