New fossil remains of an ornithopod dinosaur from the Lower Cretaceous of Ladruñán (Teruel province, Spain)

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Abstract

This study consists in the morphological characterization of an ornithopod dinosaur specimen from the Pepe paleontological site, situated in the upper part of the Barremian Mirambel Formation. This site is located in the Ladruñán anticline in the NE of the Iberian Peninsula (Maestrazgo basin, province of Teruel). The remains are found in anatomical relation and well preserved and include both axial and appendicular remains such as vertebrae, an ischium and two pubes. The pelvic girdle is the most taxonomically informative element recovered. The osteological description and taxonomic approach carried out in this work suggest that this specimen was a member of the clade Styracosterna, having some affinities with Iberian members of this clade, such as *Iguanodon*, *Mantellisaurus* and *Morelladon*.

Introduction

In recent years, up to eight species of ornithopod dinosaurs have been reported from the Lower Cretaceous of the Iberian Peninsula. *Magnamanus soriaensis* (Fuentes-Vidarte *et al*., 2016) was found in rocks from the Hauterivian-Barremian transition. *Delapparentia turolensis* (Gasca et *al*., 2015), *Portellsaurus sosbaytani* (Santos-Cubedo *et al*., 2021), *Iguanodon galvensis* (Verdú *et al*., 2017) and *Iguanodon bernissartensis* (Norman, 1980) are recorded during the Barremian. The latter taxon also is appearing in rocks from the upper Barremian and coinciding with the presence of species such as *Morelladon beltrani* (Gasulla *et al*., 2015) and *Mantellisaurus atherfieldensis* (Norman, 2014). Finally, *Proa valdearinnoensis* (McDonald *et al*., 2012b) is found at the lower Albian.

In this work, a partial ornithopod skeleton coming from the Teruel province (Spain) is studied. We carry out an osteological description of the fossil remains and compare their anatomical features with other taxa within Iguanodontia.

Geographical and geological setting

The fossil remains were recovered from the "Pepe" site, located near the village of Ladruñán (Castellote municipality), Teruel province, Spain.

Geologically, this site belongs to the eastern domain of the Iberian Range, an Alpine structure with NW-SE direction, formed by the inversion of the Jurassic-Cretaceous sedimentary basin (Álvaro *et al*., 1979). In addition, "Pepe" site is situated in the Ladruñán anticline (Morella subbasin, Maestrazgo Basin), where outcrops rocks with ages between Late Jurassic and Late Cretaceous.

Specifically, Pepe site is located within the Mirambel Formation, a continental unit which encompass alluvial plain and lacustrine deposits of Barremian age. This stratigraphic unit is a 200 m-thick succession that alternates carbonated facies interpreted as lacustrine-palustrine deposits with terrigenous facies interpreted as alluvial plain deposits (Gasca *et al*., 2017). "Pepe" is located in the upper part of the Mirambel Formation, and the fossil-bearing layer is a red-purple lutitic interval affected by pedogenic processes.

Material

The studied bones were excavated in several campaigns from 2009 to 2011 and are currently housed at the Museo de Ciencias Naturales de la Universidad de Zaragoza. The ornithopod fossil remains included in the study are a neural arch of a cervical vertebra (MPZ 2025/13), a caudal vertebra (MPZ 2025/14), an ischium (MPZ 2025/06) and two pubes (MPZ 2025/05 and MPZ 2025/07).

Osteological description and discussion

The ornithopod from Pepe possesses several characteristics that allow it to be included within the group of iguanodontian ornithopods and that make it similar to those in the Styracosterna clade.

Concerningt the cervical vertebrae, MPZ 2025/11 is similar to the neural cervical arches of *Iguanodon bernissartensis*, although it differs from the latter in that its neural spine is taller and curved posteriorly. MPZ 2025/14 fits within the general morphology of this type of vertebra (platycoelous) in Styracosterna iguanodontian taxa.

Regarding pelvic girdle, the preserved portion of the ischium MPZ 2025/06, it largely resembles *Morelladon*, with a straight ischial shaft like some taxa such as *Altirhinus* (Norman, 1998), *Barilium* (Norman, 2011), *Bayannurosaurus* (Xu *et al*., 2018), *Ouranosaurus* (Bertozzo *et al*., 2017), *Proa*, *Eolambia* (McDonald *et al*., 2012a) and *Mantellisaurus*, unlike *Hypselospinus* (Norman, 2015), *Iguanodon* and *Delapparentia*. This feature allows this ornithopod to be assigned within the Styracosterna clade. Furthermore, the morphology of the section of the ischial shaft changes along its length, a feature that is not observed in other ankylopollexian ornithopods, where this section has a "D" shape as in *Iguanodon*.

The pubes MPZ 2025/05 and MPZ 2025/07 have a similar morphology of pubes of *I. bernissartensis* and *I. galvensis*, with a dorsoventrally expanded prepubic blade and with its dorsal edge more curved than the ventral one, as occurs in *Eolambia*, *Lanzhousaurus* or *Mantellisaurus* and which differs greatly from *Iguanacolossus* (McDonald *et al*., 2010), *Bayannurosaurus*, *Magnamanus* and *Proa*. In addition, the dorsal margin of the prepubic blade is concave, another characteristic in the Styracosterna clade. Furthermore, the prepubic shaft is dorsoventrally compressed in its midsection, as in *Iguanodon*, *Eolambia*, *Altirhinus*, *Bayannurosaurus*, and *Delapparentia*, among others.

The study of the skeletal remains of the specimen from Pepe allows it to resemble other taxa recorded on the Iberian Peninsula in Barremian deposits, such as *Morelladon* and *Mantellisaurus*, with notable differences from some taxa, such as *I. galvensis*, *I. bernissartensis*, and *Delapparentia*, and with few morphological similarities with other Iberian taxa like *Proa* and *Magnamanus*. Nevertheless, the differences observed with all of the aforementioned taxa, does not allow to exclude the hypothesis of the specimen from Pepe represents a new taxon closely related to other coeval iguanodontids.

Conclusions

A partial skeleton of an ornithopod has been studied and shows several diagnostic features of Styracosterna clade, for example, the morphology of its ischial shaft and the concave dorsal margin of the prepubic blade. Compared to other Iberian styracosternan ornithopods, the Pepe specimen shares the general morphology of its pubis with *Iguanodon* and also the possession of a dorsoventrally expanded prepubic blade. Furthermore, the dorsal region of the prepubic blade projects dorsally, as in *Mantellisaurus*. It also has a dorsoventrally compressed prepubic shaft in its mid-area, a feature it shares with Iguanodon and *Delapparentia*. Finally, the ischial shaft is straight, matching with *Mantellisaurus* and *Morelladon*. Further research is needed to elucidate if the specimen from Pepe represents a new taxon for the Lower Cretaceous or is one of the closely related species described in the Iberian Peninsula.

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