A NEW HERRERASAURID DINOSAUR RECORD FROM SOUTHERN BRAZIL (UPPER TRIASSIC) AND ITS FAUNAL ASSOCIATION

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ABSTRACT – The Predebon Site, located in São João do Polêsine, Quarta Colônia region (Rio Grande do Sul, Brazil) has a Triassic fauna, including footprints and traces of small vertebrates and abundant remains of rhynchosaurs. This fauna is typical of the *Hyperodapedon* Assemblage Zone, which is correlated to the late Carnian Ischigualasto Formation (Ischigualasto-Villa Unión Basin) in Argentina. The present study records new fossil remains for the Predebon Site collected in 2001 that consists of two dorsal and two sacral vertebrae referred to the same individual (MCN-PV 10344), and two isolated, serrated blade-shaped teeth (MCN-PV 10425 and 10426). The trunk vertebrae were identified as between 11th and 15th. The sacral vertebrae are fully fused, with no indication of another fused vertebral element, not even signs suggestive of dorsosacral and caudosacral vertebrae, also because the ilia are not preserved. The general characteristics observed are: (i) lateral fossa in the vertebral body; (ii) concave ventral face of the vertebral body; (iii) neural spine high and wide at the top, subquadrangular in shape, in both dorsal and sacral vertebrae; (iv) infrapre- and infrapostzygapophyseal ridges on the dorsals; (v) presence of hyposphene and hypantrum; and (vi) first sacral vertebra larger than the second, with transverse processes and broad sacral ribs, triangular in shape in dorsal view. This set of features in the vertebral elements is similar to that present in *Herrerasaurus ischigualastensis* from the Ischigualasto Formation and allows us to consider MCN-PV 10344 as a member of the Herrerasauridae clade. It differs from *Staurikosaurus pricei*, which has three smaller and more slender sacral vertebrae and a low neural spine without subquadrangular platform at the top, and from *Gnathovorax cabreirai*, which has subrectangular platforms, slightly more elongated anteroposteriorly, suggesting the presence of a new herrerasaurid morphotype. The two isolated, serrated blade-shaped teeth were attributed to Archosauriformes indet., because this morphotype is observed in several groups within this clade.

Keywords: Dinosauria, *Hyperodapedon* Assemblage Zone, late Carnian, Predebon Site, Rio Grande do Sul, Brazil.

RESUMO – O Sítio Predebon, situado no Município de São João do Polêsine, região da Quarta Colônia (RS), possui uma fauna triássica típica da Zona de Associação de *Hyperodapedon*, incluindo pegadas e pistas de pequenos vertebrados e abundantes restos de rincossauros. Esta fauna é típica da Zona de Associação de *Hyperodapedon*, que é correlacionada à Formação Ischigualasto (Bacia Ischigualasto-Villa Unión), de idade Carniano superior, na Argentina. O presente estudo tem por objetivo registrar novos restos fósseis para o Sítio Predebon, que consiste de duas vértebras dorsais e duas vértebras sacrais referidas a um mesmo indivíduo (MCN-PV 10344), e dois dentes isolados, com bordas serrilhadas e coroa em forma de lâmina (MCN-PV 10425 and 10426). As vértebras dorsais foram identificadas como possivelmente entre 11ª e 15ª. As vértebras sacrais estão totalmente fusionadas, sem indicação de outro elemento vertebral fusionado, nem mesmo sinais sugestivos de vértebras dorsossacrais e caudossacrais, inclusive porque os ílios não estão preservados. As características gerais observadas são: (i) fossa lateral no corpo vertebral; (ii) face ventral do corpo côncava; (iii) processo espinhoso alto e largo no topo, de formato subquadrangular; (iv) cristas infrapré- e infrapós-zigapofisiárias nas dorsais; (v) presença de hiposfeno e hipantro; e (vi) a primeira vértebra sacral maior que a segunda, com processos transversos e costelas sacrais amplas, de formato triangular em vista dorsal. Esse conjunto de caracteres nas vértebras é semelhante ao observado em *Herrerasaurus ischigualastensis* da Formação Ischigualasto, permitindo considerar MCN-PV 10344 como um membro do clado Herrerasauridae. Porém, este difere de *Staurikosaurus pricei*, que apresenta três vértebras sacrais menores, gráceis e com processo espinhoso baixo e sem plataformas subquadrangulares no topo, e de *Gnathovorax cabreirai*, que possui plataformas subretangulares, pouco mais alongadas ântero-posteriormente, podendo assim, tratar-se de um novo morfotipo de herrerassaurídeo. Os dentes isolados em forma de lâmina e serrilhados foram atribuídos a Archosauriformes indet., visto que este morfótipo é observado em distintos grupos dentro do clado.

Palavras-chave: Dinosauria, Zona de Associação de *Hyperodapedon*, Carniano superior, Sítio Predebon, Rio Grande do Sul, Brasil.

INTRODUCTION

Triassic (252.2 to 201.3 Ma) sedimentary rocks with fossil tetrapod remains in South America are mainly represented in Argentina (*e.g.*, Ischigualasto-Villa Unión, Marayes-El Carrizal, Cuyo, and San Rafael Block basins; Romer, 1962; Bonaparte *et al.*, 1999; Desojo *et al.*, 2011), in Chile (*e.g.*, ´Estratos El Bordo´, Cerro Quimal; Casamiquela, 1980; Desojo, 2003; Otero *et al.*, 2023), and in Brazil (*e.g.*, Sanga do Cabral and Santa Maria supersequences of the Paraná Basin; Langer *et al.*, 2018; Schultz *et al.*, 2020). The Santa Maria Supersequence is subdivided into the Pinheiros-Chiniquá Sequence (*Dinodontosaurus* AZ), followed by the Santa Cruz Sequence (*Santacruzodon* AZ), and the Candelária Sequence (*Hyperodapedon* AZ and *Riograndia* AZ). The *Dinodontosaurus*, *Santacruzodon*, and *Hyperodapedon* AZs constitute what is also known as the Santa Maria Formation (Passo das Tropas and Alemoa members), while the *Riograndia* AZ belongs to the Caturrita Formation. Based on biostratigraphic correlations (*e.g.*, Langer, 2005; Langer *et al.*, 2007; Abdala & Ribeiro, 2010) and radiometric dating (Langer *et al.*, 2018), the upper portion of the Alemoa Member can be correlated to the Ischigualasto Formation of Argentina, thus admitting a late Carnian age (233.23 My).

Sites referred to the *Hyperodapedon* AZ (late Carnian) are numerous in RS, representing a faunal association that shows the origin and early diversification of the Dinosauria clade (*e.g.*, Colbert, 1970; Langer, 2003; Nesbitt *et al.*, 2010; Ezcurra, 2012; Müller *et al.*, 2018; Pacheco *et al.*, 2019; Novas *et al.*, 2021).

Archosauromorpha from the Candelária Sequence – RS

The Triassic deposits of the Candelária Sequence (Santa Maria and Caturrita formations) record a high diversity of archosauromorphs in the *Hyperodapedon* AZ (late Carnian) and *Riograndia* AZ (early Norian). It is represented by numerous outcrops along the Central Depression of Rio Grande do Sul (*e.g.*, Da-Rosa, 2004; Langer *et al.*, 2007; Schultz *et al.*, 2020; Martinelli *et al.*, 2021). The municipalities with abundant fossil records of these associations are Venâncio Aires, Vale do Sol, Candelária, Agudo, São João do Polêsine, Faxinal do Soturno, Santa Maria, São Pedro do Sul, and Santana da Boa Vista (Langer *et al.*, 2007; Soares *et al.*, 2011; Horn *et al.*, 2015; Pacheco *et al.*, 2018; Schultz *et al.*, 2020; Martinelli *et al.*, 2021). Major non-dinosauromorph archosaur records from the *Hyperodapedon* ZA include hyperodapedontine rhynchosaurs [*Hyperodapedon* spp. and *Teyumbaita sulcognathus* (Azevedo & Schultz, 1987)], proterochampsids (*Proterochampsa nodosa* Barberena, 1982, *Cerritosaurus binsfeldi* Price, 1946, and *Rhadinosuchus gracilis* Huene, 1942), aetosaurs (*Aetosauroides scagliai* Casamiquela, 1960), "rauisuchian" pseudosuchians (*Rauisuchus tiradensis* Huene, 1936), ornithosuchids (*Dynamosuchus collisensis* Müller *et al.*, 2020), and lagerpetids (*Ixalerpeton polesinensis* Cabreira *et al.*, 2016). For the *Riograndia* AZ an indeterminate Phytosauria (Kischlat & Lucas 2003), the lagerpetid *Faxinalipterus minima* Bonaparte *et al.*, 2010 (Kellner *et al.*,

2022) and the pterosauromorph *Maehary bonapartei* Kellner *et al.*, 2022 have been described.

Hyperodapedon and *Riograndia* AZs have important dinosaur records too; as both include a great variety of sauropodomorphs, herrerasaurids, forms of uncertain affinities (*e.g.*, *Guaibasaurus candelariensis*), and forms related to ornithischians and/or non-dinosaurid silesaurids. For a long time, the only dinosaur known for the Triassic of RS was *Staurikosaurus pricei* Colbert, 1970. In recent decades, several new species were described: *Saturnalia tupiniquim* Langer *et al.*, 1999, *Teyuwasu barberenai* Kischlat, 1999 (recently assigned as a junior synonym of *St. pricei* by Garcia *et al.*, 2019), *Pampadromaeus barberenai* Cabreira *et al.*, 2011, *Buriolestes schultzi* Cabreira *et al.*, 2016, *Bagualosaurus agudoensis* Pretto, Langer & Schultz, 2019, *Nhandumirim waldsangae* Marsola *et al.*, 2019 and *Gnathovorax cabreirai* Pacheco *et al.*, 2019.

For the *Riograndia* AZ, the known species are *Guaibasaurus candelariensis* Bonaparte, Ferigolo & Ribeiro, 1999, *Unaysaurus tolentinoi* Leal *et al.*, 2004, *Macrocollum itaquii* Müller, Langer & Dias-Da-Silva, 2018, as well as teeth and postcranial material of Sauropodomorpha indet.

Erythrovenator jacuiensis Müller, 2021 belongs to a fauna tentatively assigned to the *Riograndia* AZ (Marsola *et al.*, 2019; Miron *et al.*, 2020; Müller, 2021; but see discussions in Schultz *et al.*, 2020 and Martinelli *et al.*, 2021). An important finding of a non-sauropodomorph dinosauromorph is the species *Sacisaurus agudoensis* Ferigolo & Langer, 2006, which was initially assigned to Ornithischia. However, some authors have re-analyzed the material and interpreted it as a silesaurid (see also Novas *et al.*, 2021), a clade of the oldest dinosauromorphs recorded so far (Nesbitt *et al.*, 2019), or as a sister group of Dinosauria (Dzik, 2003; Irmis *et al.*, 2007; Brusatte *et al.*, 2010; Langer *et al.*, 2010; Nesbitt *et al.*, 2010; Nesbitt, 2011; Agnolín & Rozadilla, 2018). Some authors have suggested ornithischian affinities for the 'silesaurids' (*e.g.*, Langer & Ferigolo, 2013; Cabreira *et al.*, 2016; Müller & Garcia, 2020; Norman *et al.*, 2022). The relationships of these taxa are still controversial, but *Sacisaurus agudoensis* could be representing a basal member of Ornithischia.

Herrerasauridae

The family Herrerasauridae was established by Benedetto (1973) to include *Herrerasaurus ischigualastensis* Reig, 1963 and *Staurikosaurus pricei*, considering them as saurischian dinosaurs, restricted to the Upper Triassic of South America (Reig, 1963; Colbert, 1970; Sereno & Novas, 1992). Subsequently, the clade was defined as the group that includes "*Herrerasaurus*, *Staurikosaurus*, and their most recent common ancestor, summing all descendants" (Novas, 1992; Langer *et al.*, 2010).

The herrerasaurids have been a critically important group in the study of basal dinosaurs. This is because they have a number of skeletal adaptations that have made their phylogenetic placement difficult. They have been considered as a sister group of the Dinosauria, Saurischia, and Ornithischia (Gauthier, 1986; Brinkman & Sues, 1987;

Sereno & Novas, 1992; Novas, 1992; Fraser *et al.*, 2002), as a sister group of Theropoda and Sauropodomorpha (Padian & May, 1993; Holtz, 1995; Bonaparte & Pumares, 1995; Langer *et al.*, 1999; Galton, 2000; Langer, 2004; Benton, 2005; Ezcurra, 2006; Irmis *et al.*, 2007), or even a group of basal theropods (Sereno *et al.*, 1988, 1992; Holtz, 2011). The plesiomorphic character set added to numerous apomorphies in the cranial and postcranial skeleton, as well as the different character choices used for phylogenetic analyses, may explain the lack of consensus about the phylogenetic position of these dinosaurs (Alcober & Martínez, 2010).

The herrerasaurids in the *Hyperodapedon* AZ of Rio Grande do Sul are represented by *Staurikosaurus pricei* and *Gnathovorax cabreirai*, while in Argentina the species *Herrerasaurus ischigualastensis* and *Sanjuansaurus gordilloi* Alcober & Martínez, 2010 are found in the Ischigualasto Formation. The species "*Ischisaurus cattoi*" Reig, 1963 and "*Frenguellisaurus ischigualastensis*" Novas, 1986, were revised by Novas (1994), who suggested that both taxa would be junior synonyms of *H. ischigualastensis*.

Other records have been referred to herrerasaurids outside South America, such as in the Upper Maleri Formation of India (Novas *et al.*, 2011) and Wozniki Formation of Poland (Niedźwiedzki *et al.*, 2014), both of Norian age. Some authors (*e.g.*, Baron & Williams, 2018; but see Novas *et al.*, 2021) suggest that *Saltopus elginensis* Huene, 1910 from the Lossiemouth Sandstone Formation, Scotland, would correspond to a herrerasaurid. In North America, the species *Tawa hallae* Nesbitt *et al.*, 2009, *Chindesaurus bryansmalli* Long & Murry, 1995 and *Daemonosaurus chauliodus* Sues *et al.*, 2011, the former two from the Norian and the latter from the Rhaetic, are considered to be Herrerasauria. However, due to the fragmentary nature of the materials (with the exception of *Tawa hallae*), phylogenetic affinities are still highly debated (Novas *et al.*, 2021). According to the analyses of Novas *et al.* (2021) the North American forms are the sister group of Herrerasauridae within the more inclusive Herrerasauria clade, which encompasses only South American forms.

In this contribution we describe new dinosaur material with typical features of Herrerasauridae, as well as isolated teeth of Archosauriformes from the Predebon fossil site (São João do Polêsine Municipality), which with its faunistic association allows us to refer it to the AZ of *Hyperodapedon*. These new materials, as well as other associated archosauromorphs, are analyzed, allowing a more detailed faunal characterization of the Predebon site.

STUDY AREA CHARACTERIZATION

Geology

The Predebon site (29º38'27.8"S, 53º26'49.3"W) (Figure 1), from which the materials of the present study come from, is located in the Municipality of São João do Polêsine, Quarta Colônia region, State of Rio Grande do Sul, Brazil. The site is a cut in a private area, made for construction of a weir, about 100 m long and 6 m high (Silva *et al.*, 2011). The rocks consist of argillites, sandstones and intercalated conglomerates,

whose strata belong to the Candelária Sequence (Horn *et al.*, 2015), Santa Maria Supersequence of the Paraná Basin (Zerfass *et al.*, 2003). The locality shows an association of sedimentary facies related to deposits of temporary lacustrine bodies and ephemeral river channels (Godoy *et al.*, 2012; Ziemann & Figueiró, 2017). According to Silva *et al.* (2012), these lithological facies are divided into four rock types: (i) massive reddish clayey siltstone with calciferous nodules where there are records of Rhynchosauria (Facies 1); (ii) thin whitish or reddish tubular sandstone, massive and with calciferous nodules more towards the top of the layer, with a high occurrence of bioturbations, mainly by *Skolithos* isp. (Facies 2); (iii) thin massive reddish tabular sandstone, with planar-parallel lamination on top and invertebrate ichnofossils (*Skolithos* isp.) (Facies 3); and (iv) thin reddish/orange sandstone, with horizontal lamination, forming lenses with invertebrate ichnofossils (*Skolithos* isp. and *Arenicolites* isp.) and fossil vertebrate footprints (Facies 4). Between these facies there are intercalations, with facies 2 and 3 intercalating with Facies 1 towards the bottom of the layer, and facies 4 and 1 intercalating towards the top. Facies 1 refers to the sedimentary matrix from which the specimens of the present study (MCN-PV 10344a, b, c; MCN-PV 10425 and MCN-PV 10426) were excavated.

In the literature, the rocks that compose the upper part of the Santa Maria Formation have different faciologic interpretations. For example, in Faccini (1989) and Zerfass *et al.* (2003), the pelites are interpreted as lacustrine water bodies, and the lenticular layers could be represented by Facies 4 corresponding to small channels resulting from subaerial exposure events. Other interpretation suggests that the sequence could be formed by a fluvial system with sinuous to stable channels, where the facies described by Silva *et al.* (2012) would correspond to overbank deposits, and levels with paleosols could occur. The main channels would be tabular sandstones, while the small sandstone lenses would be related to so-called crevasse splay deposits (*e.g.*, Fonseca & Scherer, 1998; Schultz *et al.*, 2000).

Paleofauna from the Predebon Site

The fossil record for the Predebon Site presents a Triassic fauna typical of the *Hyperodapedon* AZ. There are bioturbation ichnofossils (cited above with the sedimentary facies corresponding to their occurrences), including nine fossil footprint morphotypes: *Rhynchosauroides* isp., *Rhynchosauroides retroversipes* Silva *et al.*, 2008, *Rhynchosauroides*? isp., plus autopod drag marks, *Procolophonichnium* isp., plus indet. tetrapod footprints and tridactyl footprints attributed to indeterminate dinosaurs and the ichnogenus *Grallator*? isp. (Silva *et al.*, 2007a, b, c, 2008; Francischini *et al.*, 2018; Klein & Lucas, 2021).

Besides the ichnofossils, the remaining fossils for the Predebon Site correspond to rhynchosaur elements, some of which were assigned to *Hyperodapedon* sp., based on cranial traits, by Baó *et al.* (2016). Silva *et al.* (2022) proposed that some rhyncosaur specimens can be referred to *Hyperodapedon mariensis* (Tupi-Caldas, 1933). In addition to rhynchosaurs,
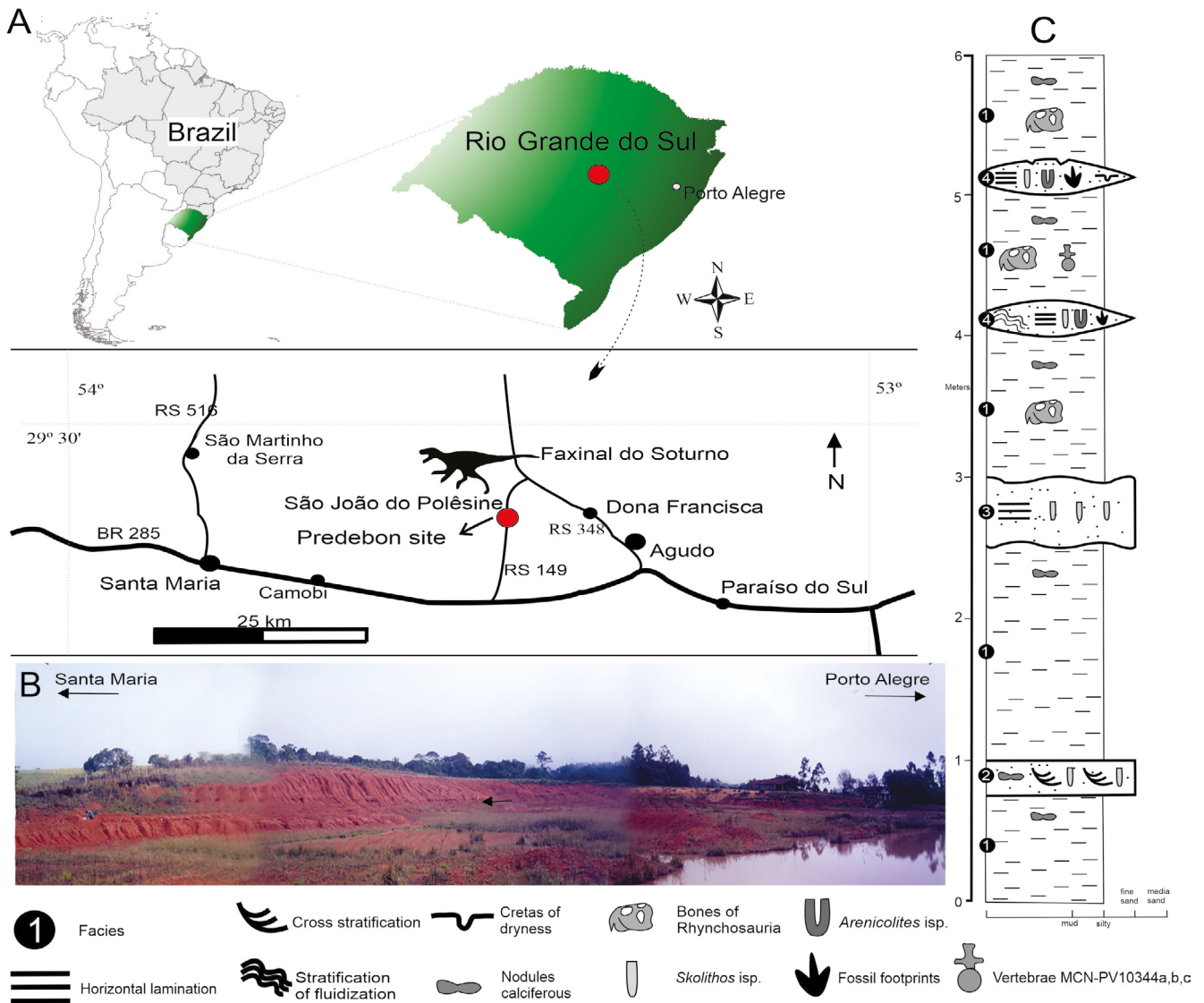
Figure 1. **A**, location map of part of the central depression region in Rio Grande do Sul where the Municipality of São João do Polêsine is indicated; **B**, general view of the Predebon Site, with a arrow that marks the collection point for the dorsal and sacral vertebrae. **C**, detailed section of the outcrop (modified from Silva *et al.*, 2008).

isolated teeth of archosauriforms and postcranial elements of indeterminate dinosaurs are also found, as well as the vertebrae attributed here to Herrerasauridae. The fauna listed for this locality, mentioned in Appendix 1, is deposited at the Museu de Ciências Naturais, Secretaria de Meio Ambiente e Infraestrutura (MCN/SEMA), Porto Alegre, RS, Brazil.

MATERIAL AND METHODS

The specimens described in the present study were collected at the Predebon Site during the execution of the Pro-Guaíba Project in June 2001. They are housed in the Scientific Paleontology Collection of the Paleontology Section of the Museu de Ciências Naturais (MCN), Secretaria Estadual do Meio Ambiente e Infrastrutura (SEMA-RS), under the acronym MCN-PV. Specimen MCN-PV 10344a, b,

c corresponds to two dorsal and two sacral vertebrae (S1 and S2) with their respective fused ribs, and some indeterminate fragments, referred to the same individual. The remaining specimens are MCN-PV 10426 and MCN-PV 10427, which consist of two isolated teeth with a blade-shaped crown.

Small saws, tweezers, brushes, and the *Dremel Multi Pro* tool were used to prepare the material under study, and, for preservation, Polyethylene glycol 4000 and Methylacrylate diluted in acetone PA were used. The description was made under direct observation of the specimens and comparison with the Triassic dinosaur type-material from Rio Grande do Sul and Argentina, as well as the literature (*e.g.*, Sereno *et al.*, 1993; Sereno, 1999; Sereno & Novas, 1992, 1994; Langer, 2003; Bonaparte *et al.*, 2007; Bittencourt & Kellner, 2009; Cabreira *et al.*, 2011, 2016; Alcober & Martínez, 2010; Novas, 2012; Pacheco *et al.*, 2019; Pretto *et al.*, 2019; Novas *et al.*, 2021).

We used terms from the Veterinary Anatomical Nomina (I.C.V.G.A.N., 2012); but 'anterior' and 'posterior' are used as directional terms rather than the veterinary alternatives 'cranial' and 'caudal', respectively; thus, we considered measurements with anterior, posterior, lateral, dorsal, and ventral views.

MCN-PV 10344 was compared with dinosaurs from the Triassic of South America, especially late Carnian taxa from the *Hyperodapedon* AZ of Brazil and Ischigualasto Formation of Argentina.

For phylogenetic analysis, we included specimen MCN-PV 10344 within the data matrix of Novas *et al.* (2021). The data matrix was analyzed under equally weighted parsimony using TNT 1.5 (Goloboff *et al.*, 2008; Goloboff & Catalano, 2016). We performed a heuristic search (random addition sequence + tree bisection reconnection), with 1000 replicates of Wagner trees (with random seed = 0) and using tree bisection reconnection and branch swapping (holding ten trees save per replication). The resulting most parsimonious tree and the score for MCN-PV 10344 are included in the Supplementary Material.

SYSTEMATIC PALEONTOLOGY

DINOSAURIA Owen, 1842
SAURISCHIA Seeley, 1887
HERRERASAURIDAE Benedetto, 1973

Herrerasauridae gen. et sp. indet.
(Figures 2–4, Tables 1–2)

Material. MCN-PV 10344a, b, c, two posterior dorsal vertebrae (possibly between D11 and D15), and two sacral vertebrae.

Locality, unit, and age. Predebon site, *Hyperodapedon* Assemblage Zone, Candelária Sequence, late Carnian, Upper Triassic.

Description. The dorsal vertebrae were not preserved articulated. Morphological analysis allowed the classification of specimen MCN-PV 10344a, b, as vertebral elements of distinct positions, due to the presence or absence of pits, laminae, crests and of structures that compose them. They
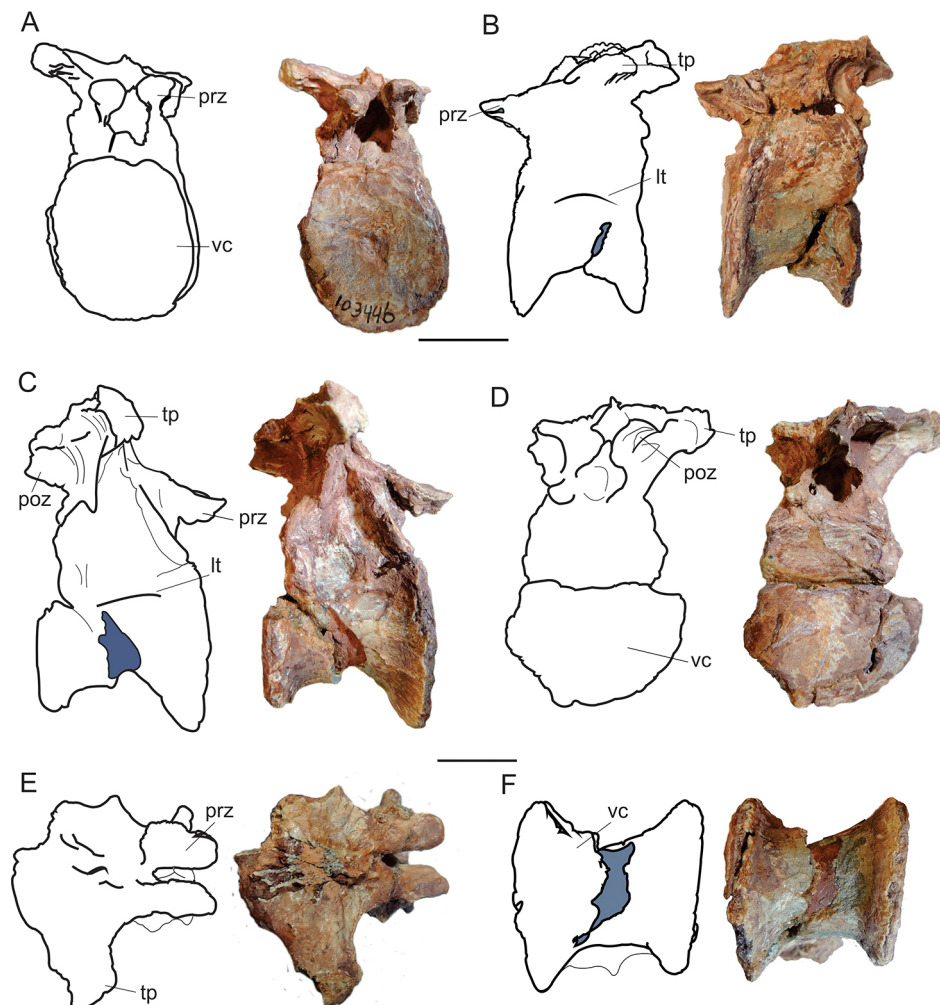
Figure 2. Posterior dorsal vertebra D11?, MCN-PV 10344a. **A**, anterior view; **B**, right lateral view; **C**, left lateral view; **D**, posterior view; **E**, dorsal view and **F**, ventral view. **Abbreviations: lt**, lateral fossa; **poz**, postzygapophysis; **prz**, prezygapophysis; **tp**, transverse process; **vc**, vertebral centrum. Scale bars = 20 mm.
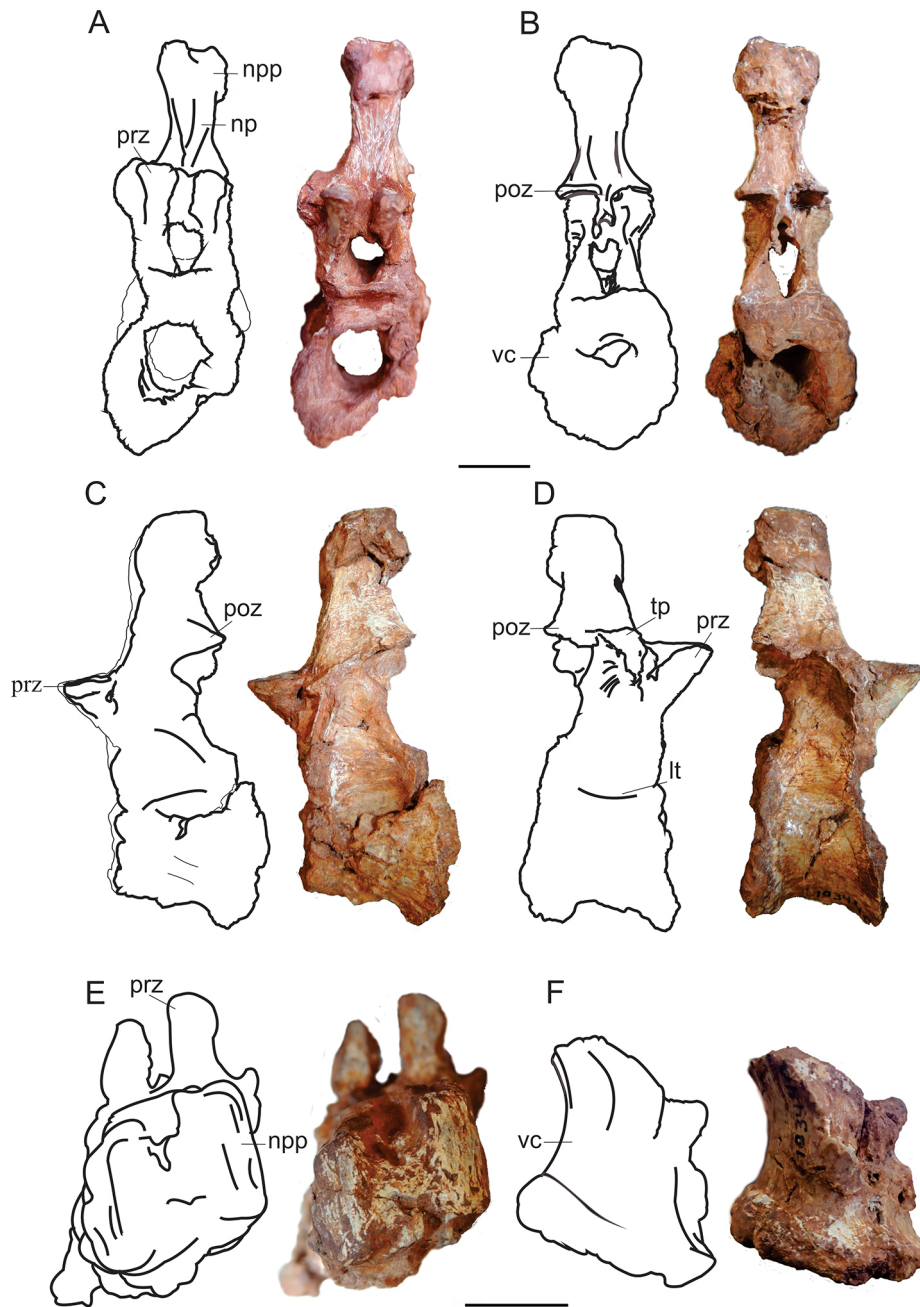
Figure 3. Posterior dorsal vertebra D15?, MCN PV-10344b. **A**, anterior view; **B**, posterior view; **C**, left lateral view; **D**, right lateral view; **E**, dorsal view and **F**, ventral view. **Abbreviations: lt**, lateral fossa; **np**, neural spine; **npp**, neural spine platform; **poz**, postzygapophysis; **prz**, prezygapophysis; **tp**, transverse process; **vc**, vertebral centrum. Scale bars = 20 mm.

correspond likely vertebrae located between the 11th and 15th positions (Figures 2 and 3), based on comparison with dorsal sequences of *Herrerasaurus* (Novas, 1992, 1994; Sereno & Novas, 1992). In the text they are referred to as D11? (MCN-PV 10344a) and D15? (MCN-PV 10344b), respectively. The D11? vertebra does not preserve the dorsal region of the neural arch, being fractured above the level of the zygapophyses, the left transverse process is not complete, and the distal end of the postzygapophysis is not preserved, and the vertebral centrum is

fractured but complete. The D15? vertebra is almost complete, missing only part of the anterior region of the vertebral body, and the transverse process shows a deformation, which was possibly compressed during the fossildiagenesis process. The sediment that filled the vertebral centrum was lost. The dorsal vertebrae have anteroposteriorly short centra and high neural arches as in other herrerasaurids (Novas, 1994; Bittencourt & Kellner, 2009; Alcober & Martínez, 2010). The D11? vertebra has as anteroposteriorly short and amphicelic

Table 1. Measurements (cm) of dorsal vertebrae D11? (MCN-PV 10344a) and D15? (MCN-PV 10344b).

Measurements/ Dorsal Vertebrae	D11?	D15?
Overall height	–	9.2
Neural arch height (neural arch base to top of neural spine)	–	5.4
Anterior articular face width	3.1	–
Anterior articular face height	3.3	–
Posterior articular face width	3.4*	3.6
Height of the posterior articular face	3.6	3.95
Vertebral body length (side view)	2.97	3.0*
Length of top neural spine (dorsal view)	–	1.6
Width of the top of the neural spine	–	1.7

Legend: x = cannot be measured; * = approximately.

Table 2. Measurements (cm) of sacral vertebrae S1 and S2 (MCN-PV 10344c).

Measurements/Sacral vertebrae	S1	S2
Overall height	6.7	6.1
Neural arch height (neural arch base to top of spine neural)	3.7	3.6
Anterior articular face width	4.5	–
Anterior articular face height	3.1	–
Posterior articular face width	–	3.8
Posterior articular face height	–	2.7
Vertebral body length (ventral view)	4.0	3.6
Vertebral centrum width (ventral view)	2.54	3.3
Sacral width (preserved)	10.9	11.5
Length of top neural spine (dorsal view)	1.57	2.0
Width of the top of the neural spine	1.5	1.6

vertebral centrum. The centrum is strongly contracted in the middle portion in lateral view; the ventral face of the vertebral body is concave, has a lateral fossa, and is fused to the neural arch. The neural arch is anteroposteriorly short, as well as the transverse process. The diapophysis connects to infra-prezygapophyseal and infra-postzygapophyseal laminae, which surround deep cavities present laterally in the neural arch. Pre- and postzygapophyses are well developed. The prezygapophysis is elongated anteroposteriorly, overlying the anterior face of the vertebral centrum, and is oriented dorsally. The postzygapophysis is shorter, but with a higher position in the neural arch compared to the prezygapophysis. D11? is slightly smaller than the D15? vertebra. The latter has a short anteroposteriorly vertebral centrum, a concave ventral face, and laterally it presents a fossa, apparently deeper than that of the vertebral centrum of D11?. The centrum is fused to the neural arch, which is also anteroposteriorly short. It does not present a system of laminae like the infrapre- and infrapostzygapophyseal ones, and is more robust than the neural arch of D11?. The prezygapophysis is elongated anteroposteriorly, extending beyond the anterior face of the vertebral centrum, and the postzygapophysis is shorter.

Accessory intervertebral joints are present. The hypantro is seen adjacent to the prezygapophysis as a medial, vertical surface. The hyposphene is below the postzygapophysis and with a clear articular surface. The neural spine is anteroposteriorly short, high and represents almost 1/3 of the total height of the vertebra at D15? (Table 1). The anterior and posterior surfaces of the neural spine have longitudinal grooves, giving the process an "H" shape in cross section. The top of the neural spine is wide with robust, subquadrangular-shaped lateral borders.

The sacrum (MCN-PV 10344c) is constituted of two totally fused primordial sacral vertebrae, with no indication of another fused vertebral element, nor even signs suggestive of dorsosacral and caudosacral vertebrae because the ilia are not preserved. The co-ossification of the neural arches to the sacral bodies indicates a state of skeletal maturity (Figure 4; Table 2; link to 3D Image in Supplementary Material). Fusion of sacral centra appears to be uncommon in members of Herrerasauridae; however, it has been observed in other coeval sauropods (Moro *et al.*, 2020; Griffin *et al.*, 2022). The first sacral vertebra (S1) is larger than the second sacral (S2), both with robust ribs. The sacrum is dorsoventrally flattened, possibly due to compression during fossildiagenesis; the vertebral centrum, especially of the first vertebra project slightly anteriorly, the neural spine in S1 and S2 have fractures, but are complete. The sacral vertebrae have amphicelic vertebral centra, the ventral surface of both S1 and S2 are concave as is the last dorsal vertebra (D15?), but the vertebral centrum in S1 is longer anteroposteriorly and transversely narrower than D15?; the transverse processes and sacral ribs are broad, triangular in shape and in dorsal view form an almost continuous platform, but with foramen interrupting the structure. The prezygapophysis is anteroposteriorly elongated; however, it does not extend beyond the anterior face of the vertebral centrum, possibly due to the flattening of the sacrum. The postzygapophysis is short. Accessory articulations are present, the hyposphene is seen next to the prezygapophysis and the hyposphene is placed below the postzygapophyses. The neural spine is high in S1 and S2, with strong longitudinal ridges on the anterior and posterior faces. The top of the neural spine is broad, subquadrangular in appearance, with the first sacral vertebra (S1) being more robust than the second (S2), and with a subquadrangular dorsal end larger than that present in S2 and D11?

ARCHOSAURIFORMES Gauthier, 1986
Archosauriformes indet.

(Figure 5)

Material. MCN-PV 10425 and MCN-PV 10426, two isolated serrated teeth, both with laminar crown.
Locality, unit, and age. Predebon site, *Hyperodapedon* Assemblage Zone, Candelaria Sequence, late Carnian, Upper Triassic.
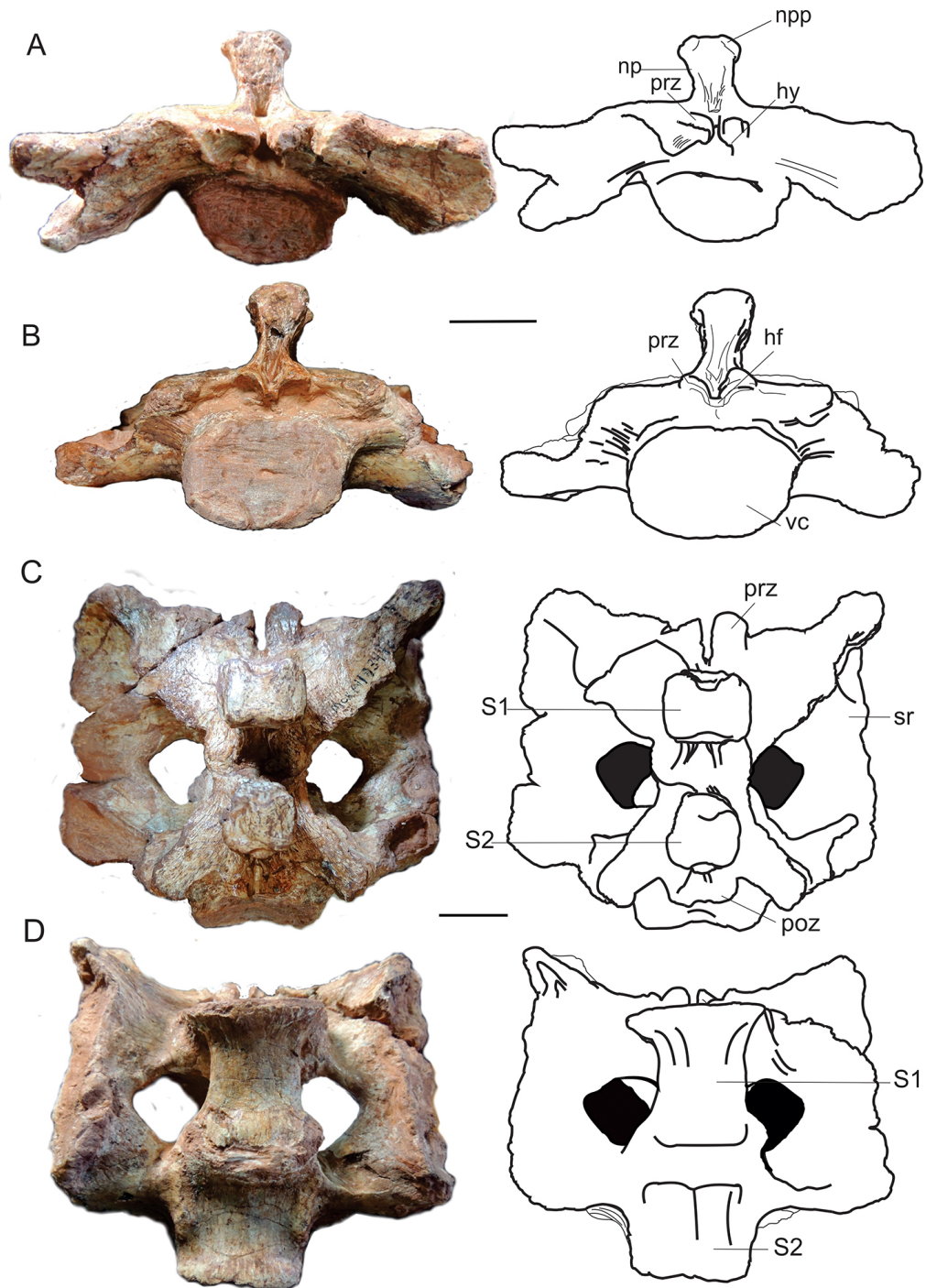
Figure 4. Sacrum MCN-PV 10344c. **A**, anterior view; **B**, posterior view; **C**, dorsal view; and **D**, ventral view. **Abbreviations: hf**, hyposphene; **hy**, hypantrum; **np**, neural spine; **npp**, neural spine platform; **poz**, postzygapophysis; **prz**, prezygapophysis; **sr**, sacral rib; **S1**, first sacral vertebra; **S2**, second sacral vertebra; **tp**, transverse process; **vc**, vertebral centrum. Scale bars = 20 mm

Description. The two teeth are of different sizes, being the smallest MCN-PV 10425 and MCN-PV 10426 the largest. They are characterized by an oval-shaped crown base in cross-section with labial-lingual compression, one of the faces being flatter than the other, here considered as lingual (Figure 5). The teeth have asymmetric margins: the mesial margin is convex, and the distal margin is convex until the apex of the crown. The serrations on the distal margin are small and form a right angle with the main axis of the tooth. The mesial and distal margins are serrated in MCN-PV 10425 and in MCN-PV 10426. Three denticles per millimetre are observed on the distal margin in the middle sector, which towards the
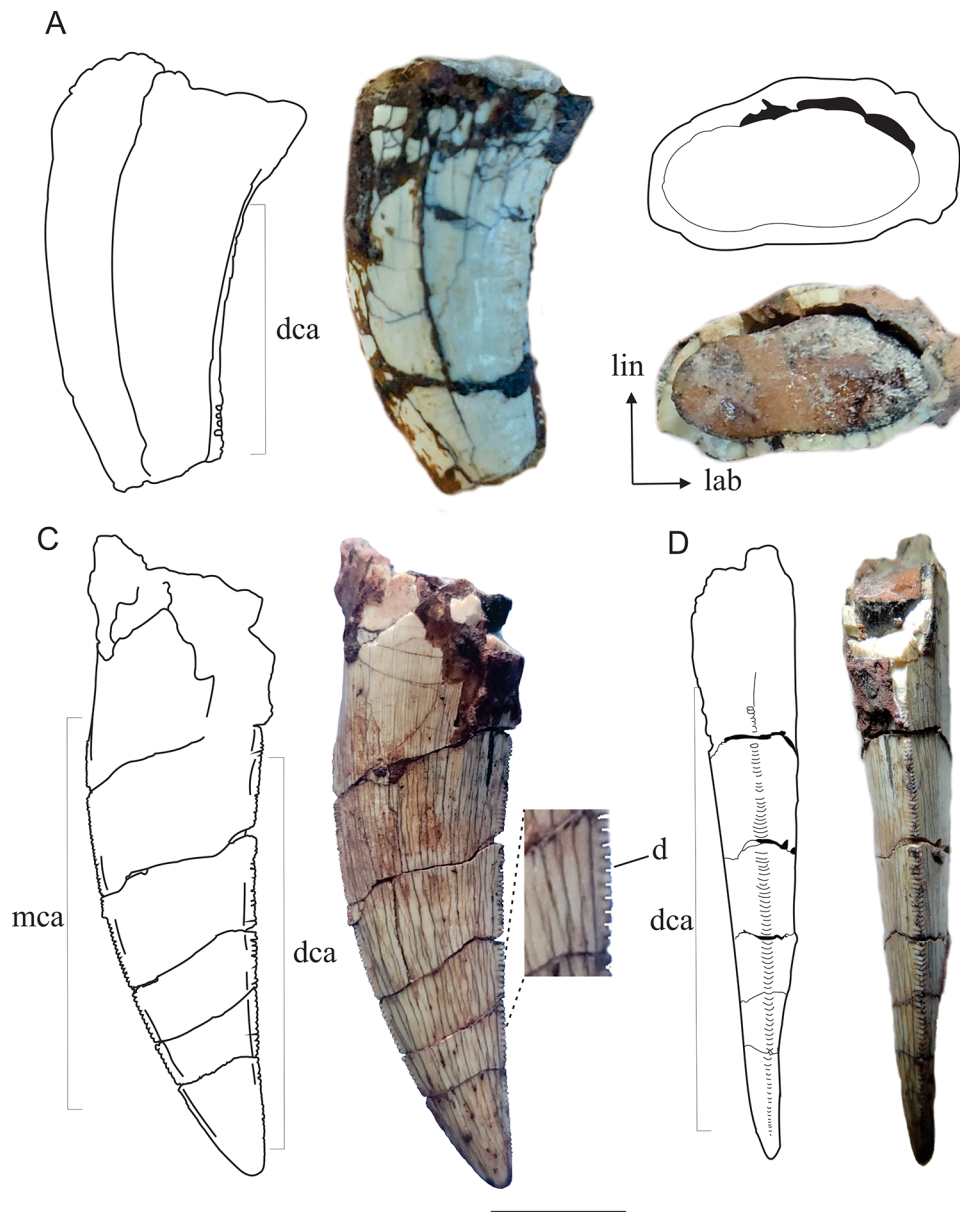
Figure 5. MCN-PV 10425 and MCN-PV 10426, isolated teeth. **A**, labial view (MCN-PV 10425). **B**, proximal view; **C**, lingual view; **D**, distal view (MCN-PV 10426). **Abbreviations: d**, denticles; **dca**, distal carina; **mca**, mesial carina; **lab**, labial; **lin**, lingual. Scale bar = 10 mm.

apex decrease in size; the denticles have a rectangular shape (wider than tall). The largest tooth (MCN-PV 10426) presents light apical wear.

COMPARATIVE DISCUSSION

Herrerasauridae indet. MCN-PV 10344

MCN-PV 10344 differs from sauropodomorphs from the Carnian of South America, such as *Pampadromaeus barberenai*, *Bagualosaurus agudoensis*, and *Eoraptor lunensis* Sereno *et al*., 1993, in having neural arches of the dorsal vertebrae that are higher dorsoventrally and shorter anteroposteriorly. Besides, the neural spine of the dorsal vertebrae in these Carnian sauropodomorphs is laminar,

anteroposteriorly elongated and transversely narrow (Cabreira *et al*., 2011; Müller *et al*., 2018; Pretto *et al*., 2019). It comprises about 80-90% of the length of the vertebral centrum in *B. agudoensis*. However, the dorsal vertebrae MCN-PV 10344a, b have the transversely broad and anteroposteriorly short neural spine, generating a sub-rectangular cross-section with a platform at the top that has well-marked edges. The vertebral centrum of the dorsal vertebrae in Carnian sauropodomorphs have a reel shape, being anteroposteriorly elongated and amphicoelous (*e.g.*, Müller *et al*., 2018; Pretto *et al*., 2019), whereas in MCN-PV 10344, the dorsal vertebral bodies are short anteroposteriorly, as observed in *Herrerasaurus*.

MCN-PV 10344a, b has dorsal vertebral elements quite distinct from those present in the Norian species:

Guaibasaurus candelariensis, *Unaysaurus tolentinoi*, *Macrocollum itaquii*, and *Sacisaurus agudoensis*. In these taxa the neural spine is anteroposteriorly elongated and laminar in shape. In *G. candelariensis* the vertebral centrum is lower and proportionally more elongated than that observed in MCN-PV 10344. In *U. tolentinoi* the vertebral centrum is strongly compressed, a common condition for basal sauropodomorphs (Galton, 1990), the prezygapophyses are also shorter than in MCN-PV 10344. The dorsal vertebrae in *M. itaquii* have anteroposteriorly shorter neural spine compared to the neural spine present in the cervical vertebrae in the same taxon, but still maintain the laminar shape, which differs from MCN-PV 10344. In *S. agudoensis*, the two dorsal vertebrae are poorly preserved, but both the best-preserved vertebra (atlas) and the caudal vertebrae, are markedly smaller than MCN-PV 10344 and have a more elongated vertebral centra.

With respect to the sacral vertebrae, *Pampadromaeus barberenai* also has two sacral vertebrae (Cabreira *et al.*, 2011; Moro *et al.*, 2020), but the neural spine is laminar, being anteroposteriorly elongated and transversely narrower (Cabreira *et al.*, 2011). The neural spine is also laminar in the sacral vertebrae of other Carnian sauropodomorphs, being transversely narrow and anteroposteriorly elongated, similar also to other non-herrerasaurid basal dinosaurs (Raath, 1969; Galton, 1977; Cooper, 1981; Langer, 2003), but differing from the condition present in MCN-PV 10344c.

With respect to the number of sacral vertebrae, *Buriolestes schultzi* has three vertebrae (Müller *et al.*, 2018) while MCN-PV 10344c has only two. The sacral vertebrae of *Bagualosaurus agudoensis* includes two primordial vertebrae, as in MCN-PV 10344c, but differs from our specimen by the presence of an additional caudosacral vertebra (Pretto *et al.*, 2019). In *Nhandumirim waldsangae* the sacrum is composed of three vertebrae, and their ventral surface is less concave in lateral view than in the proximal dorsal and caudal vertebrae (Marsola *et al.*, 2019). The second sacral of *N. waldsangae* is longer than wide compared to the third sacral, while in MCN-PV 10344c they are shorter than the third sacral of *N. waldsangae*.

Thus, it is observed that in Sauropodomorpha three to four sacral vertebrae are present, two primordial plus one dorsosacral and/or caudosacral, as in the Argentinean taxon *Eoraptor lunensis*. This latter has three vertebrae that connect to the ilium, and are thus considered sacral (Sereno *et al.*, 2012). Other taxa, such as *Panphagia*, *Coloradisaurus*, *Chromogisaurus*, and *Riojasaurus*, have only one or no preserved primordial sacral vertebrae (Bonaparte, 1971, 1978; Galton, 1990; Martínez & Alcober, 2009; Ezcurra, 2010). MCN-PV 10344 is tentatively considered an herrerasaurid, mainly because it has an arrangement of characters that differs from that found in Triassic sauropodomorphs, including those from Rio Grande do Sul. Based on the two dorsal vertebrae and the sacrum of MCN-PV 10344, it is possible to observe the morphological difference from the plan commonly observed for Sauropodomorpha, whose vertebrae have a neural spine transversely narrow and more elongated than high. Such characters are not present in MCN-PV 10344,

as the neural spine is anteroposteriorly short, with an ''H'' shaped top in cross section. This being a condition present in herrerasaurids, observed for example in the Brazilian taxon *Gnathovorax cabreirai* and the Argentinean taxon *Herrerasaurus ischigualastensis*.

The dorsal vertebrae resemble those of the herrerasaurid *Sanjuansaurus gordilloi*, since they present a conspicuous concavity in lateral view at the vertebral centra, also observed in the more distal dorsal vertebrae (such as the 15th) of *Herrerasaurus ischigualastensis*. This feature is observed from the first to the eleventh dorsal vertebrae, decreasing slightly in the twelfth through the fifteenth (Alcober & Martínez, 2010). The distal end of the neural spine visible on D15? of MCN-PV 10344 is characterized by a subquadrangular platform. It is present on the last dorsal vertebra in *Sa. gordilloi* (Alcober & Martínez, 2010), and is similar to that of *H. ischigualastensis* according to Novas (1994).

We noticed a similarity with *Staurikosaurus pricei* in the vertebral body, which is short anteroposteriorly, amphicelic and concave ventrally, as in MCN-PV 10344, but the vertebrae of *St. pricei* are less robust. The neural spine of *St. pricei* vertebrae is high, with slightly concave anterior and posterior margins, which makes the ends of the neural spine appear wider than the intermediate region (Bittencourt & Kellner, 2009). On the other hand, in MCN-PV 10344 the neural spine is broad at the top and subquadrangular in shape.

Gnathovorax cabreirai has the complete cervico-dorsal series preserved, with nine cervical and 16 articulated dorsal vertebrae. They present a longitudinal keel on the ventral surface in the center of some vertebrae, mainly in the most anterior dorsals, as in the other herrerassaurids (Novas, 1994; Alcober & Martínez, 2010; Pacheco *et al.*, 2019), but in MCN-PV 10344 the ventral keel is not visible, even because they are more posterior dorsal vertebrae.

A ventral keel is absent in all dorsal vertebrae of *Sanjuansaurus gordilloi*, as well as in specimen MCN-PV 10344, although in the last cervical vertebra a prominent keel is visible in *Sa. gordilloi*. The size of the neural arch is almost twice as large as that of the vertebral centrum, a characteristic that in *Herrerasaurus ischigualastensis* is well defined (Novas, 1994). The transverse process of the dorsals of MCN-PV 10344 is triangular as in *H. ischigualastensis* and *Staurikosaurus pricei* (Sereno & Novas, 1994; Galton, 1977). The two dorsal vertebrae are anteroposteriorly short and with high neural arches as in *H. ischigualastensis*, features observed in *St. pricei* and *Sa. gordilloi* (Novas, 1994; Colbert, 1970; Bittencourt & Kellner, 2009; Alcober & Martínez, 2010). Mainly in the D11? vertebra, the centrodiapophyseal, infrapostzygodiapophyseal and infraprezygodiapophyseal laminae are well developed, as in *H. ischigualastensis* and *Sa. gordilloi*. These three laminae connect the subtriangular fossae: infraprezigapophyseal, infradiapophyseal and infrapostzygapophyseal (Figure 6A). And these fossae converge below a horizontal roof formed by the diapophysis and pre- and postzygodiapophyseal laminae as in *Herrerasaurus* (Figure 6C).
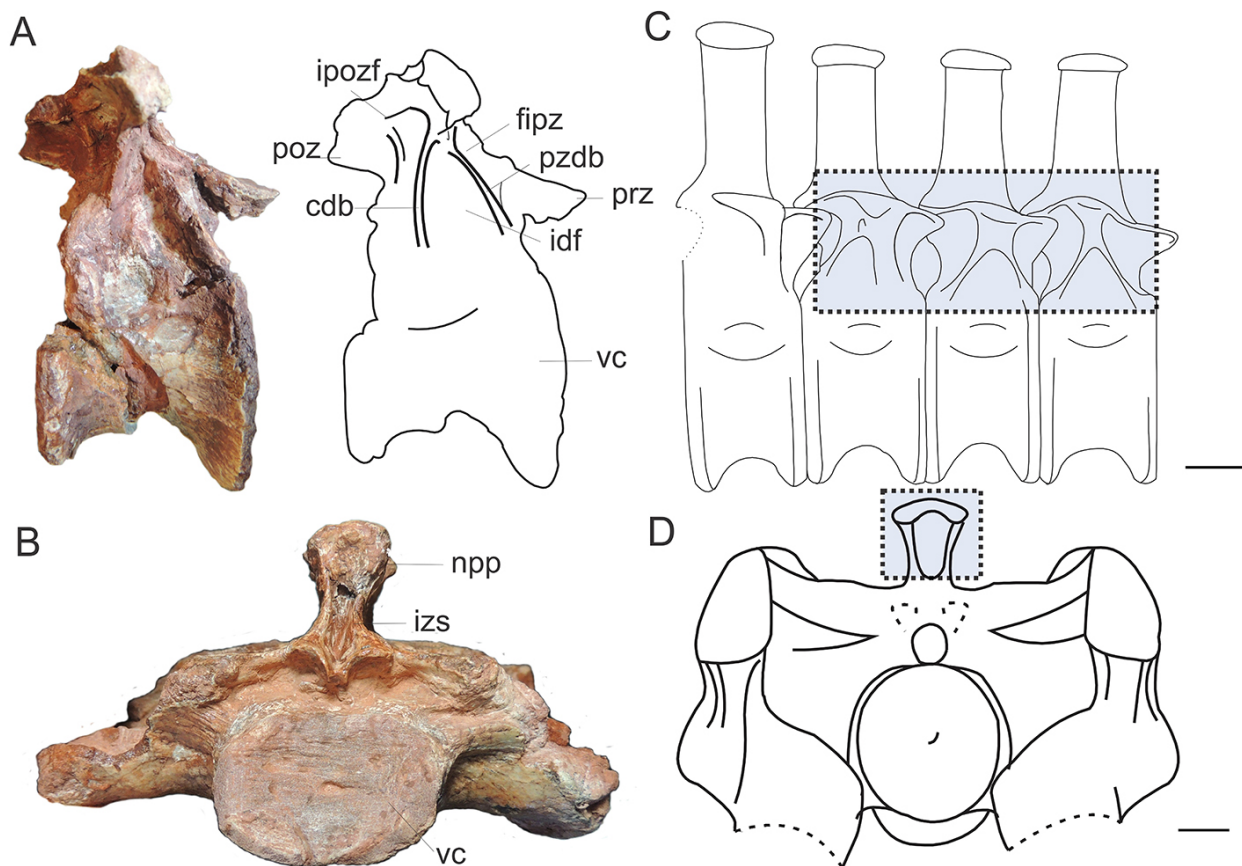
Figure 6. A, D11? dorsal vertebra (MCN-PV 10344a) in lateral view, comparing lamina and fossa (blue frame) with **C**, drawing of the dorsal vertebraeof *Herrerasaurus ischigualastensis*. **B**, sacrum of MCN-PV 10344c in posterior view, comparing the sulcus of the neural spine and subquadrangular platform with **D**, sacrum of *H. ischigualastensis*. **C'–D'**, drawing from Novas (1994). **Abbreviations: cdb**, centrodiapophyseal blade; **cv**, vertebral centrum; **hf**, hyposphene; **hy**, hypantrum; **idf**, infradiapophyseal fossa; **ipozf**, infrapostzygapophyseal fossa; **ipzf**, infraprezygapophyseal fossa; **izs**, interzygapophyseal sulcus; **ns**, neural spine; **npp**, neural spine platform; **poz**, postzygapophysis; **poz**, postzygapophysis; **prz**, prezygapophysis; **S1**, first sacral vertebra; **S2**, second sacral vertebra. Scale bars = 25 mm.

An interzigapophyseal sulcus separates the pre- and postzygapophyses in MCN-PV 10344c (Figure 6B). This sulcus extends to the anterior and posterior borders of the neural spine as in *Herrerasaurus ischigualastensis* (Figure 6D), *Staurikosaurus pricei* and *Sanjuansaurus gordilloi* (Novas, 1994; Bittencourt & Kellner, 2009; Alcober & Martínez, 2010). In D11? of MCN-PV 10344a, a well-developed hyposphene is present, similar to that present in *H. ischigualastensis* and *Sa. gordilloi* (Novas, 1994; Alcober & Martínez, 2010).

The sacrum of MCN-PV 10344c shows differences when compared to that of *Staurikosaurus pricei*. In the latter the vertebrae are smaller and more gracile, and the neural spine is low and without subquadrangular platforms on top. In *St. pricei* the presence of three sacral vertebrae has been suggested, due to the presence of scars on the medial side of the ilium (Bonaparte *et al.*, 1999); however, in our specimen there are only two sacral vertebrae, as in *Herrerasaurus*. In *Gnathovorax cabreirai* the sacrum is composed of two primordial sacral vertebrae, as in MCN-PV 10344c. Nonetheless, a dorsal element seems to project between the ilia. In MCN-PV 10344c the contact of a possible dorso-sacral is not preserved. Due to the sediment, it is not possible to

observe the longitudinal grooves on the anterior and posterior faces of the neural spine of the vertebrae of *G. cabreirai*. The lateral fossa in the vertebral body is not as marked as in MCN-PV 10344c and *H. ischigualastensis*.

Like the last dorsal described here, the sacral vertebrae in MCN-PV 10344c have a high and broad neural spine at the top. They are subquadrangular in appearance and have strong longitudinal ridges on the anterior and posterior surfaces, as seen in *Herrerasaurus ischigualastensis* (Figure 7). In *Gnathovorax cabreirai* the neural spines of sacral vertebrae one and two apparently have a more subrectangular shape, being anteroposteriorly more elongated, as seen in the second sacral vertebra of *H. ischigualastensis*.

In MCN-PV 10344c the sacral vertebrae are fully incorporated into the sacrum, as noted by Sereno & Novas (1994) in *Staurikosaurus pricei*. The sacrum is composed of only two primordial vertebrae that are coossified (Figures 4C, D). In MCN-PV 10344 the first sacral is more robust than the second. In *Sanjuansaurus gordilloi* the first sacral is 10% larger than the second (Alcober & Martínez, 2010). The height of the neural spine of MCN-PV 10344, on the other hand, is quite pronounced and very similar to that of *H. ischigualastensis*.
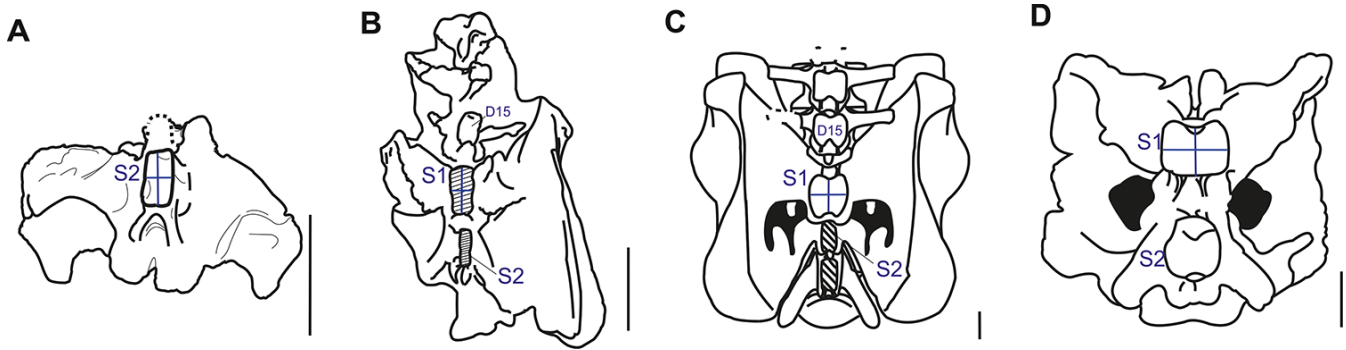
Figure 7. Comparison of sacrum and vertebral elements in herrerasaurids (*Staurikosaurus pricei*, *Gnathovorax cabreirai* and *Herrerasaurus ischigualastensis* and MCN-PV 10344) in dorsal view. **A**, sacral vertebra in *St. pricei*; **B**, sacrum of *G. cabrerai* indicating the first sacral vertebra (S1) and 15ª dorsal vertebrae (modified from Pacheco *et al.*, 2019. Note that the distal portion of the process is not preserved); **C**, sacrum of *Herrerasaurus ischigualastensis* indicating the first sacral vertebra (S1) and 15ª dorsal vertebrae (modified from Novas, 1994); **D**, sacrum of MCN-PV 10344 indicating the first sacral vertebra (S1). Scale bars: A = 30 mm; B = 50 mm; C = 25 mm; D = 20 mm.

The anterior and posterior sides of the neural spine of the two sacral vertebrae have median grooves that extend between the pre- and postzygapophyses, as in *H. ischigualastensis* and *Sa. gordilloi* (Novas, 1994; Alcober & Martínez, 2010). The neural spines in the dorsal and sacral vertebrae of MCN-PV 10344 resemble *H. ischigualastensis* and *Sa. gordilloi*, mainly by the presence of the subquadrangular platform at the top of the neural spines (Figures 7C, D). In *Gnatovorax cabreirai*, this platform is slightly more elongated, with a sub-rectangular shape. In MCN-PV 10344c the hyposphene- and hypantro-joints are present, as in *H. ischigualastensis* (Novas, 1994) and occur commonly in sauropod dinosaurs (Sereno & Novas, 1992). The infrapre- and infrapost-zygapophyseal blades in MCN-PV 10344 are described for *H. ischigualastensis* and *Sa. gordilloi*, and also occur in other basal dinosaurs.

The vertebral centrum of the two sacral vertebrae (MCN-PV 10344) is transversely wide, similar to *Herrerasaurus ischigualastensis*. The sacral ribs of S1 and S2 are characterized by broad continuous distal attachment surfaces, forming a C in lateral view; large subcircular openings are present where the sacral ribs and centra articulate, as in *H. ischigualastensis* and in *Sanjuansaurus gordilloi* in the second and third sacral vertebrae (Novas, 1994; Alcober & Martínez, 2010). Due to preservation and/or preparation it is not possible to observe this characteristic in *Gnathovorax cabreirai*, for example.

The difference observed in specimen MCN-PV 10344 when compared to *Staurikosaurus pricei* and *Sanjuansaurus gordilloi* is in the number of sacral vertebrae. In *St. pricei* and *Sa. gordilloi* the sacrum is composed of three vertebrae, as the presence of a dorsosacral articulated with the ilium is mentioned for these two species. However, as in *Gnathovorax cabreirai*, MCN-PV 10344 also consists of two sacral vertebrae. This character supports the interpretation originally recognized by Novas (1994) that there are only two vertebrae in the sacrum of *H. ischigualastensis*. Thus, this is an important trait for counting primordial sacral vertebrae. The inclusion of MCN-PV 10344 within the data matrix from Novas *et*

al. (2021) does not add information to the discussion here provided. It resulted in 152 most parsimonious trees of 1403 steps and a consensus strict tree which generated a massive politomy where MCN-PV 10344 joints herrerasaurids, several sauropodomorphs and other non-dinosaurian taxa (*e.g.*, *Lagosuchus*) (see figure in Supplementary Material).

Archosauriformes indet.

The two teeth described here (MCN-PV 10425 and MCN-PV 10426) have serrations on the mesial and distal margins. If related to herrerasaurids, this suggests that both are more closely related to the maxilla, as the premaxilla and dentary teeth have only the distal margin serrated in Herrerasauridae (Novas, 1994; Pacheco *et al.*, 2019). The crowns are recurved and transversely narrow, typical of theropods [*e.g.*, *Coelophysis bauri* (Cope, 1887)], and are similar to those of *Gnathovorax cabreirai* and *Herrerasaurus ischigualastensis*. However, this morphology is also present in some of the basal sauropodomorphs described in South America, such as *Buriolestes schultzi* and *Eoraptor lunensis*. The crowns differ from that seen in herbivorous/omnivorous sauropodomorphs (*e.g.*, *Bagualosaurus agudoensis*), whose dentition is lanceolate. They also differ from the zyphodont teeth of faunivorous sauropodomorphs (*e.g.*, *Buriolestes schultzi*), as well as from posterior teeth, in that these have the leaf-like crown with a basal constriction. Other Triassic archosauriforms have also ziphodont dentitions, such as "rauisuchians", ornithosuchids and phytosaurs (*e.g.*, Ray & Chinsamy, 2002; Renesto *et al.*, 2003; Macedo de Oliveira & Pinheiro, 2017). However, these latter taxa have less transversely compressed teeth and more irregularly serrated carinae. The taxonomic assignment of specimens MCN-PV 10425 and MCN-PV 10426 to Herrerasauridae is not excluded. However, broader studies and comparisons are needed to confirm their relationship to this clade. Thus, in the present contribution, they are considered as Archosauriformes indet.

CONCLUSIONS

The specimen MCN-PV 10344, along with the two isolated teeth (MCN-PV 10425 and MCN-PV 10426), contribute to the record of medium to large predators for the Predebon Site, where the paleofauna is dominated by rhynchosaurs. Besides, MCN-PV 10344 indicates the occurrence of a new morphotype of herrerasaurid, which expands the morphological characteristics for the group.

Currently, herrerasaurid records for the Triassic of Rio Grande do Sul are restricted to two species (*i.e.*, *Staurikosaurus pricei* and *Gnathovorax cabreirai*) in addition to undetermined materials (*e.g.*, Garcia *et al*., 2021), all from *Hyperodapedon* AZ of the Candelária Sequence. The Predebon Site is located 1.3 km from the Marchezan Site (type locality of *Gnathovorax cabreirai*), and belongs to the *Hyperodapedon* AZ. However, MCN-PV 10344, although fragmentary, differs from *G. cabreirai*. The latter taxon has a sacrum with a subretangular neural spines, whereas in MCN-PV 10344 it is subquadrangular, similar to *Herrerasaurus ischigualastensis* (Figure 7). In MCN-PV 10344 the transverse processes appear almost on the entire lateral surface of the sacral vertebrae, forming more subcircular foramen than in *G. cabreirai*. The specimen is also larger than *G. cabrerai*. MCN-PV 10344 has more robust neural spines and more robust appearance when compared to those of *St. pricei*. Although these features may indicate a new morphotype of herrerasaurid in the Triassic of Rio Grande do Sul, it is not possible to consider the specimen as a new genus or species. This is because it may still represent an ontogenetic or intraspecific variation, besides presenting strong deformation resulting from diagenetic processes. Thus, we indicate the presence of a herrerasaurid for the Predebon Site, extending the number of localities with records of Herrerasauridae for the Triassic of Rio Grande do Sul, Brazil.

ACKNOWLEDGMENTS

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Appendix 1. Paleofauna from the Predebon site, material deposited at the Museu de Ciências Naturais, SEMA/RS.

Register	Material/number of specimens	Identification	Collection Date (month/year)
MCN-PV 1875	Right mandible fragment (1)	*Hyperodapedon mariensis*	04/97
MCN-PV 1876	Fragments of left maxilla (5)	*Hyperodapedon mariensis*	04/97
MCN-PV 1877	Skull fragments (26)	Rhynchosauria	
MCN-PV 2297	Left tibia (1)	Dinosauria	04/97
MCN-PV 2713	Humerus fragment (1)	Rhynchosauria	09/97
MCN-PV 2716	Fragments: skull; vertebrae (2); finger phalanx I (1), phalanges fused (2); gastralia; indeterminate fragments (1)	*Hyperodapedon* sp.	09/97
MCN-PV 3502	Rib fragments (2)	Rhynchosauria	04/97
MCN-PV 3503	Vertebral body (1)	Rhynchosauria	04/97
MCN-PV 3505	Fragmented bones: small vertebra (1); distal portion of tibia (1); postcranium (6)	cf. *Hyperodapedon* juvenile	09/97
MCN-PV 3588	Isolated tooth (1)	Archosauriformes indet.	09/01
MCN-PV 3589	Isolated tooth (1)	Archosauriformes indet.	09/01
MCN-PV 3590	Isolated tooth (1)	Archosauriformes indet.	09/01
MCN-PV 3603	Left ilium (1); rib fragment (1)	Rhynchosauria	09/01
MCN-PV 3604	Right scapulo-coracoid (1); rib (1); gastralia	Rhynchosauria	09/01
MCN-PV 10344	Dorsal vertebrae (2); sacrum (1) with two fused vertebrae	Herrerasauridae	06/01
MCN-PV 10349	Fragments of mandible (left) (2)	*Hyperodapedon mariensis*	12/00
MCN-PV 10350	Fragments: skull (22); right (2) and left premaxilla (1); right maxilla (1)	*Hyperodapedon mariensis*	09/01
MCN-PV 10351	Fragment of postcranium (1) quadrate (1); phalanx (1) ungual phalanx (1).	Rhynchosauria	11/99
MCN-PV 10352	Fragments: mandible (left) (1); skull (6); postcranium (63*).	*Hyperodapedon mariensis*	06/01
MCN-PV 10425	Blade-shaped, serrated tooth (1)	Archosauriformes indet.	01/02
MCN-PV 10426	Blade-shaped, serrated tooth (1)	Archosauriformes indet.	01/02
MCN-PV 10427	Left ischium (1)	*Hyperodapedon* sp.	01/02
MCN-PV 10428	Fragments: mandible (right) (1); vertebrae (4)	*Hyperodapedon* sp.	
MCN-PV 10429	Fragments: skull (8), postcranium (69); jaws (6); right maxilla (1); left premaxilla (1); jaw (right) (1); jaw (left) (1); vertebral centra (2); phalanges (3)	*Hyperodapedon mariensis*	03/02
MCN-PV 10430	Fragments: skull (18), postcranium (82); right premaxilla (1); rib (1); vertebra (1);	*Hyperodapedon* sp.	10/05
MCN-PV 10431	Femur (1); postcranial fragment (1)	*Hyperodapedon* sp.	–

* = approx.