A new species of Pararhizomys (Tachyoryctoidinae, Muroidea) from Linxia Basin of Gansu Province (Postprint)

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Abstract

An anterior part of skull was recently found near Xiayangwan in Guanghe County, Gansu Province, presumably from the Liushu Formation. The skull represents a new species of Pararhizomys, named as Pararhizomys parvulus. The new species is characterized by: small size, upper molars higher crowned and mesio-lingually hypsodont with sinus deeper than mesosinus; sinus and mesosinus in M3 being transverse and overlapping each other, but sinus longer than mesosinus on occlusal view. Based on shared apomorphies (lingually hypsodont upper molars and transverse sinus and mesosinus on M3 occlusal surface), P. parvulus and P. huaxiaensis are supposed to form a sister group. However, P. parvulus may be more derived than P. huaxiaensis as demonstrated by the more hypsodont molars and the deeper sinus in M3.

Full Text

A New Species of Pararhizomys (Tachyoryctoidinae, Muroidea) from the Linxia Basin of Gansu Province

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Abstract

An anterior portion of a skull was recently discovered near Xiayangwan in Guanghe County, Gansu Province, presumably from the Liushu Formation. This specimen represents a new species of *Pararhizomys*, designated as *Pararhizomys parvulus*. The new species is characterized by its small size, high-crowned

upper molars that are mesio-lingually hypsodont with the sinus deeper than the mesosinus, and transversely oriented sinus and mesosinus in M3 that overlap one another, with the sinus being longer than the mesosinus in occlusal view. Based on shared apomorphies—lingually hypsodont upper molars and transverse sinus and mesosinus on the M3 occlusal surface—*P. parvulus* and *P. huaxiaensis* appear to form a sister group. However, *P. parvulus* may be more derived than *P. huaxiaensis*, as evidenced by its more hypsodont molars and deeper sinus in M3.

Keywords: Linxia Basin, Gansu; Late Miocene; Liushu Formation; *Pararhizomys*, Tachyoryctoidinae

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Introduction

Pararhizomys represents one of the Late Miocene–Early Pliocene endemic rodent groups inhabiting the middle latitudes of East Asia. The genus was established by Teilhard de Chardin and Young (1931) based on the type species *Pararhizomys hipparionum*, which was described from a left mandible with m1–3 from the Late Miocene "Pontian Red Clay" (= Baodean ALMA) in Shaanxi Province. Subsequent discoveries have referred additional material, including skulls and mandibles from Mongolia and Nei Mongol, China, to this species (Kowalski, 1968; Li, 2010). Recently, four species (*P. hipparionum*, *P. qinensis*, *P. huaxiaensis*, and *P. longensis*) and additional *Pararhizomys* spp. have been reported from the Late Miocene of northern China (Zhang et al., 2005; Qiu and Li, 2008; Li, 2010; Wang and Qiu, 2018).

In 2018, while prospecting the Xiayangwan area in Guanghe County of the Linxia Basin, a field team from Northwest University recovered an anterior portion of a *Pararhizomys* skull from the surface deposits of the middle Liushu Formation. Dr. Xie Kun, a member of the Northwest University team, kindly entrusted the specimen to the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) for identification and further study. Our analysis indicates that this skull represents a new species of *Pararhizomys*, described herein as *Pararhizomys parvulus*. This discovery provides valuable new information on the morphology and phylogeny of the genus. Terminology and measurements of the skull and cheek teeth follow Wang and Qiu (2018). This research was supported by the Key Research Program of Frontier Sciences, Chinese Academy of Sciences (Grant No. QYZDY-SSW-DQC022) and the Strategic Priority Research Program (B) of the Chinese Academy of Sciences (Grant No. XDB26000000).

Systematic Paleontology

Muroidea Illiger, 1811
Spalacidae Gray, 1821
Tachyoryctoidinae Schaub, 1958
Pararhizomyini Wang & Qiu, 2018
Pararhizomys Teilhard de Chardin & Young, 1931
Pararhizomys parvulus sp. nov. (Figs. 1, 2; Table 1)

Holotype: IVPP V 26661, an anterior portion of a skull with two I2s, left M1–3 and right M1–2, collected from the surface of the Liushu Formation near Xiayangwan, Guanghe County (Field Locality: E 103º31 55.54 , N 35º27 25.76 , H 2091 m above sea level).

Age: Probable middle Late Miocene.

Diagnosis: A small-sized *Pararhizomys* with molars that are higher-crowned than those of the four known species, being mesially and lingually hypsodont. M1–3 possess a sinus that is vertically deeper than the mesosinus. In M3, the sinus and mesosinus are transverse and overlap one another, with the sinus being wider than the mesosinus transversely.

Etymology: *Parvulus*, Latin for "little."

Description

Skull: The skull is small among muroid rodents and exhibits a myomorphous zygomasseteric structure. The length of the anterior portion (from the anterior end of the premaxilla to the anterior margin of M1) measures approximately 13.2 mm.

Dorsal View (Fig. 1E): The nasal (N) is mostly preserved, though its anterior end is missing. Fortunately, the impression of the anterior portion is well preserved, revealing its anterior boundary. The nasal is relatively wide and wedge-shaped, tapering gradually posteriorly to a pointed posterior end that lies roughly on the same transverse line as the posterior ends of the premaxillo-maxillary sutures. The dorsal surface of the nasal is convex longitudinally and slightly convex transversely, with prominent transverse convexity anteriorly that becomes flat posteriorly. The premaxilla (Pm) is divided by the premaxillary laterodorsal crest (pmldc) into two parts: a long, band-like dorsal portion that is slightly convex longitudinally and flat transversely, and a broad, slightly concave lateroventral portion. The straight posterior portion of the premaxillo-maxillary suture extends posteriorly to meet the frontal (F), forming obtuse angles with both the maxillo-frontal and premaxillo-frontal sutures. The maxillo-frontal suture extends posterolaterally to meet the small lacrimal bone (L), forming a distinct lacrimal tubercle (lt).

Lateral View (Fig. 1C, D): The anterior end of the nasal lies nearly in the same vertical line as that of the premaxilla (Pm). The infraorbital foramen

(iof) is situated within the maxilla. Both left and right infraorbital foramina are poorly preserved but appear to have an oval upper part and a ventral slit of the infraorbital foramen (vsiof) below.

Ventral View (Fig. 1A): The left and right upper diastemata each measure 10 mm in length, exceeding the length of the molar rows. The two incisive foramina (inf) are each 3 mm long, approximately three-tenths the length of the upper diastemata, and are positioned in the middle of the diastemata. The ventral portion of the premaxillo-maxillary suture extends mesioposteriorly, intersecting the posterior part of the incisive foramen. The zygomatic plate is located ventrolateral to the infraorbital foramen, expanding anterolaterally and facing anterolaterally. The attachment area for the lateral masseter muscle on the zygomatic plate is broad and concave, with a distinct arched anterior rim (araml). The masseteric tubercle (mt) is located at the mesial end of the araml, nearly on the same transverse line as the posterior end of the inf. Between the mt and M1 lies a bulge representing the posterior end of the alveolus of I2. The left and right molar rows diverge posteriorly. A sagittal ridge extends along the intermaxillary and interpalatine sutures from the space between the incisive foramina to the posterior border of the palate. The two palatine sulci (ps) extend posteriorly from the incisive foramen, becoming deeper near the molar rows. A pair of posterior palatal foramina (ppf) is located in the palatine sulci, at a level mesial to the molar rows.

Teeth: The upper dental formula is 1.0.0.3. The molars are high-crowned, mesially and lingually hypsodont with roots. The occlusal surfaces have two or four reentrants and two or three lophs. Specimen V 26661 represents a young individual, as all molars are slightly worn and all reentrants remain open.

The M1 is the largest of the upper molars, with a round-angled rectangular occlusal outline that is longer than wide, featuring a slightly longer buccal side than lingual side. It possesses two buccal reentrants (anterosinus and mesosinus) and two lingual reentrants (protosinus and sinus). The mesosinus is the longest reentrant transversely, with its lingual end turning slightly posteriorly. The anterosinus extends nearly transversely. The sinus is slightly shorter transversely than the anterosinus and extends slightly anterobuccally toward the anterosinus. On the buccal side, the anterosinus is vertically deeper than the mesosinus. On the lingual side, the sinus is deeper vertically than both the anterosinus and mesosinus. The dentine tract (DT) on the buccal side is M-shaped, with two sharp peaks reaching the bottoms of the anterosinus and mesosinus. The protosinus appears as a very shallow groove in occlusal view but is vertically deeper than the sinus on the anteromesial wall of M1.

The M2 is trapezoidal in occlusal view, slightly wider than long, with a convex posterior side. It has one buccal reentrant (mesosinus) and one lingual reentrant (sinus). The mesosinus is transversely longer than the sinus and extends posterolingually. The sinus extends transversely in front of the mesosinus and is deeper than the mesosinus on the lateral side. On the buccal side, the sharp peak of the DT reaches the bottom of the mesosinus.

The M3 is smaller than M2 and subquadrate in occlusal view, with a slightly narrower posterior side. Like M2, it has one buccal reentrant (mesosinus) and one lingual reentrant (sinus), with the sinus being vertically deeper than the mesosinus. In occlusal view, the mesosinus and sinus extend transversely, but the sinus is longer than the mesosinus in width. Because the sinus lies slightly more anterior than the mesosinus, the two reentrants overlap and join each other.

The I2 is orthodont, bending strongly with its anterior end turning ventrally. Its posterior end originates from the maxilla in front of M1. The cross-section of I2 is triangular, with a rounded lingual angle and an almost flat labial side. Enamel covers the entire labial side and less extensively on the medial and lateral sides. A prominent longitudinal ridge on the labial side is located nearer to the medial side than to the lateral side.

Comparison and Discussion

The anterior portion of skull IVPP V 26661 preserves the following diagnostic features of Pararhizomyini: myomorphous zygomasseteric structure; a nasal with a pointed posterior end located nearly on the same transverse line as the posterior end of the premaxillo-maxillary suture; a distinct premaxillary laterodorsal crest (pmldc) parallel to the anterior part of the naso-premaxillary suture; an upper diastema longer than the molar row; a broad zygomatic plate located ventrolateral to the infraorbital foramen (iof); a lateral masseter muscle attachment area confined to the maxilla and bordered anteriorly by a distinct curved ridge (araml); and upper molars that are mesially hypsodont with roots, having simple occlusal features lacking a posterosinus, with M2–3 possessing only one lingual reentrant (sinus).

Pararhizomyini comprises two genera: *Pararhizomys* (Teilhard de Chardin & Young, 1931) and *Pseudorhizomys* (Wang & Qiu, 2018). In V 26661, the nasal has a longitudinally convex dorsal side with its anterior end in the same vertical line as the anterior end of the premaxilla; the dorsal part of the premaxilla bordered by the pmldc is long and band-like; the posterior part of the premaxillo-maxillary suture is straight and extends posteriorly to meet the frontal, forming an obtuse angle with the maxilla-frontal suture while its anterior part intersects the posterior portion of the incisive foramen; I2 is orthodont with a triangular cross-section and a well-developed longitudinal crest on the labial side; and three upper molars are mesially hypsodont, with M2 and M3 having only one buccal reentrant (mesosinus) and lacking an anterosinus. In all these features, V 26661 is more similar to *Pararhizomys* than to *Pseudorhizomys*.

The genus *Pararhizomys* currently includes four species: *P. hipparionum*, *P. qinensis*, *P. huaxiaensis*, and *P. longensis*. Specimen V 26661 differs from all of these in its much smaller size. The anterior portion of the skull and the maxillary diastema are shorter than half the lengths of those in *P. hipparionum* and *P. huaxiaensis*, or approximately half the length of *P. longensis*. The molars are

only about three-fifths the length of those in the four aforementioned species.

Furthermore, V 26661 differs from *P. hipparionum*, *P. qinensis*, and *P. longensis* in having higher-crowned, lingually hypsodont upper molars. It differs from *P. hipparionum* in that M1–3 have a sinus that is vertically deeper than the buccal reentrants; from *P. qinensis* in that M1–2 have a deeper sinus than mesosinus; from *P. huaxiaensis* in that M3 has a sinus deeper than the mesosinus with overlapping reentrants on the occlusal surface; and from *P. longensis* in that M1–3 are more mesially and lingually hypsodont and M3 has transverse sinus and mesosinus.

Based on these comparisons, establishing a new species of *Pararhizomys* is clearly warranted, here named *P. parvulus*.

Wang and Qiu (2018: fig. 75) discussed relationships among the four previously known *Pararhizomys* species, suggesting that *P. longensis* may represent the earliest and first split branch of *Pararhizomys*, while *P. huaxiaensis* is the sister taxon of *P. hipparionum* + *P. qinensis*. Compared with these four species, *P. parvulus* shares with *P. huaxiaensis* the apomorphies of M1–3 being both mesially and lingually hypsodont (character 4-2 in Wang and Qiu, 2018:128) and the sinus and mesosinus of M3 being transverse (character 5-1). However, *P. parvulus* exhibits more hypsodont molars and M3 with overlapped sinus and mesosinus on the occlusal surface and a vertically deeper sinus than in *P. huaxiaensis*. These features suggest that *P. parvulus* may represent a more progressive and specialized branch of the *P. huaxiaensis* + *P. parvulus* sister group.

The locality yielding the *Pararhizomys parvulus* skull lies stratigraphically above the Dashengou Fauna locality, suggesting that *P. parvulus* may derive from the upper part of the middle Liushu Formation or slightly higher strata. Its age is likely middle Late Miocene or slightly later.

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Note: Figure translations are in progress. See original paper for figures.