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New Suid remains of genus *Listriodon* from the Siwaliks of Pakistan

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ABSTRACT: *New dental remains of the genus Listriodon (Mammalia, Suidae) have been found and described from the Lower to Middle Miocene Siwalik beds located around Hasnot, district Jhelum, Punjab, Pakistan. The present material consists of an isolated upper second premolar and a second molar of the upper left side. The presence of an advanced listriodont in Pakistan at an early stage provides valuable insights into the timing of the development of specific characteristics associated with lophodonty in Listriodontinae. Furthermore, it prompts significant inquiries into the early evolution of Listriodontinae in the Old World. The presence of significant physical resemblance between Listriodon guptai and Listriodon akatikubas, an African species discovered in the late early Miocene era, indicates a high likelihood that the latter species migrated from Asia. The provided specimens offer novel insights and supplementary details regarding the dental characteristics of Listriodon pentapotamiae, a species found in the Lower to Middle Siwaliks of Pakistan.*

Keyword: Artiodactyla, *Listriodon pentapotamiae*, Miocene, Siwalik hills, Suidae

INTRODUCTION

Suids are known as even-toed ungulates, and they can be found in large numbers

in the Siwalik region of Northern Punjab as well as in other parts of these hills (Draz et al., 2020, 2021). Beginning in the nineteenth century and continuing

onward, numerous scholars, including Colbert (1935), Falconer (1868), Lydekker (1883), Pickford (1988), Pilgrim (1926), and Stehlin (1899), excavated diverse locations on the hills of the subcontinent, where they found a large number of fossils. Amongst many others, Ahmad (1995), Batool et al. (2015), Ghaffar and Akhtar (2012), Made (1996, 1998), Made et al. (2022), and Jasinki et al. (2023) are among the most well-known Palaeontological researchers that have conducted studies in this region. Despite this, there have been a significant number of other paleontological experts who have carried out research in this region. A few millennia ago, the family Suidae was among the most ubiquitous families in the Siwaliks of the Indo-Pak region and was represented by a significant number of genera. This was due to the family's ability to produce a vast number of offspring (Mörs et al., 2019; Pickford and Obada, 2016; Spassov et al., 2018). However, despite the fact that many species from that time had a significant number of fossil records discovered over and over again, others had exhibited significantly fewer fossils that

represented them. As a result, the discovery of any additional examples of these ancient species is of utmost significance for gaining an accurate comprehension of the part they played and where they stood in the course of the evolution of this particular group. Each of the five component formations, i.e., Soan Formation, Dhok Pathan Formation, Nagri Formation, Chinji Formation, and Kamliyal Formation is clearly visible in the region around Hasnot (Ghaffar and Akhtar, 2012).

Listriodon pentapotamiae exhibits a wide geographic distribution, spanning from the lower Siwalik region to the upper Middle Siwalik beds. Size was the primary factor that led Lydekker to differentiate between *L. theobaldi* and *L. pentapotamiae*. He conceded that there was no consistent structural difference that could be established between the teeth of *L. theobaldi*, which are smaller, and the teeth of *L. pentapotamiae*, which are larger. Recent research conducted by Pickford and Morales concluded that the two species, *L. theobaldi* and *L. pentapotamiae*, are indistinguishable from one another (Pickford and Morales, 2003).

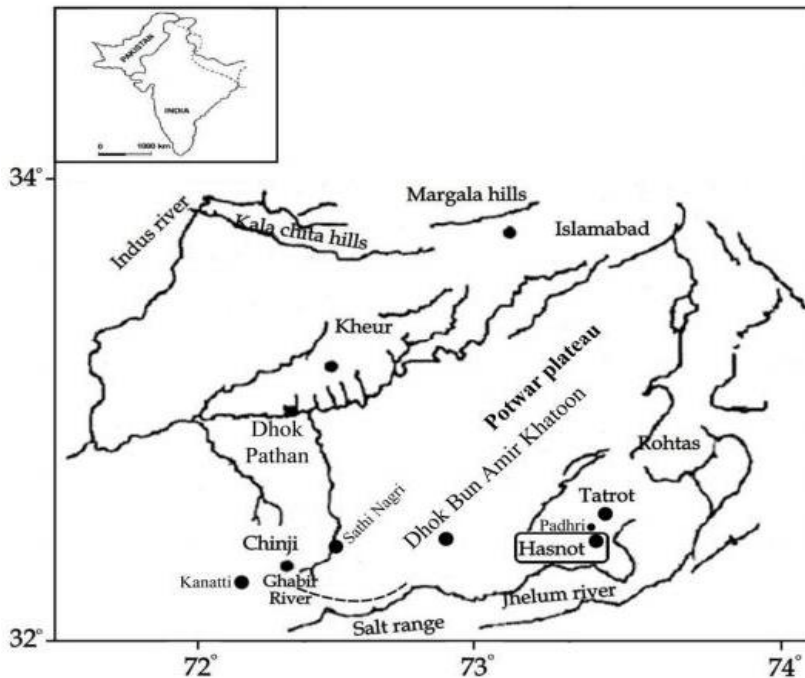


Fig. 1: Map showing different fossil-bearing localities of the Potwar Plateau in Punjab and northern Pakistan (Barry et al., 2002), the studied area is highlighted

MATERIAL AND METHODS

The specimens that are currently being described were gathered in the Kamliyal and Chinji Formation in Punjab, Pakistan, in the general region of the Hasnot hamlet. During the field visits, they were found either partially or fully exposed in the formations present around Hasnot, from where they were excavated carefully with the help of field hammers, chisels, fine needles, and brushes and then transferred carefully to the Palaeontological laboratory of GC University, Lahore by covering them in several layers of cotton. Then, once again, they were carefully cleaned and

washed by using different brushes, needles, water, cotton, etc., in order to make them ready for their morphological identification. They are currently being stored in the collections of the Palaeontology Laboratory at the Department of Zoology at Government College (now known as GC University) in Lahore, Pakistan. The measurements were performed with a metric Vernier caliper and were recorded in millimeters (mm). The morphometric features of the specimens under investigation are examined. The specimens in question are assigned a serial catalog number, and the figures associated with these specimens represent the numerator

(serial number) and the denominator (collection year). For example, Government College Palaeontological Collection Number 383/2001 (where "Government College Palaeontological Collection Number" is abbreviated as "G.C.P.C. No."). The nomenclature used to describe the parts of the dental crown and the methods of measurement are based on (Pickford, 1988).

Abbreviations used

G.C.P.C. Palaeontological Collection is stored in the Zoology Department, Government College, Lahore, Pakistan.

P.U.P.C. Palaeontological Collection is stored in the Zoology Department, Punjab University, Lahore, Pakistan.

P.M.N.H. Pakistan Museum of Natural History, Islamabad.

RESULTS

The following results are drawn after the detailed study of these recovered specimens from the study site.

Systematic Palaeontology

Order Artiodactyla Owen, 1848

Family Suidae Gray, 1821

Genus *Listriodon* Von Meyer, 1846

Species *Listriodon pentapotamiae*
(Falconer)

Specimen under study

1. G.C.P.C. No. 383/2001 is an individual upper second premolar located on the right side. It was obtained from Hasnot, a region situated in District Jhelum, Punjab, Pakistan.
2. G.C.P.C. No. 366/2001 represents an individual's isolated upper second molar located on the left side. It was obtained from Hasnot, a region situated in District Jhelum, Punjab, Pakistan.

Description

The morphological description of the material under study is given as follows:

Upper Dentition. Second Premolar (Fig. 2)

The specimen identified and cataloged as G.C.P.C. No. 383/2001 is an individual upper second premolar located on the right side. It was obtained from Hasnot, a region situated in District Jhelum, Punjab, Pakistan. The tooth has exceptional preservation. The overall shape of the tooth closely resembles that of a triangle. It has a pressure imprint on both its front and posterior surfaces. The tooth exhibits a high height-to-width index, indicating

its classification as a highly hypsodont tooth. The tooth under study exhibits a tapering shape in the anterior region and gradually widens as it extends toward the posterior aspect. Its present state indicates that the process of weathering just touches it. It is a narrow, crowned specimen.

The premolar being examined exhibits an extended shape in the anteroposterior direction and is compressed in the transverse direction. The thickness of the enamel layer exhibits uniformity

throughout the entirety of the crown surface. It exhibits a lustrous appearance and possesses a certain degree of corrugation. The tooth has a thin cingulum layer that is situated on both the anterior and posterior aspects. This layer manifests as a prominent cingular ridge, which is unevenly elevated on both the front and the back side of the specimen. The cingulum is almost completely absent on the lateral sides of the tooth.

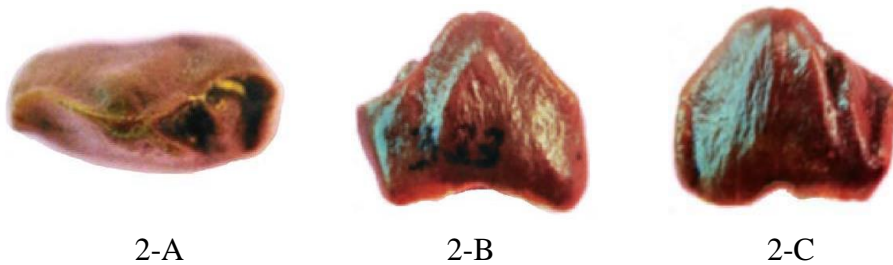


Fig. 2: Crown view (2-A), Lingual view (2-B), and Labial view (2-C) of G.C.P.C. No. 383/2001.

The metacone is the anterior-most cusp of the present specimen. The vertical height of the metacone is less than the protocone of the tooth. On the front side of the lingual aspect of the tooth, there is a little bit of vertical depression that separates the metacone to some extent from the protocone. Labially, it is in continuation with that of the protocone of the tooth. The protocone is the vertically highest and the strongest cone of the tooth, which is present almost in the middle of the tooth. It is conical in its present appearance. Paracone is next

to the protocone, which is slightly lower than the protocone in vertical height. Both the protocone and the paracone, which together constitute what is known as the proto-para complex, are fused to produce a structure that looks like a ridge. Both of the cones form this complex.

The hypocone of the premolar under study is thick and low in its vertical height. It is separated from all the other principal cusps of the tooth by a deep, shallow vertical groove. Its vertical height is almost the same as that of the

vertical height of the metacone, which is the anterior-most cusp of the tooth. All the principal cusps of the tooth are present in a straight line and are well observed.

Upper Dentition. Second Molar (Fig. 3)

The specimen G.C.P.C. No. 366/2001 represents an individual isolated upper second molar located on the left side. It was obtained from Hasnot, a region situated in District Jhelum, Punjab, Pakistan. The tooth is well preserved. The enamel layer exhibits a substantial thickness and possesses a nearly uniform and lustrous appearance encompassing the primary cusps of the tooth. The sample is almost squarish in its general contour. An evident pressure mark is observed on both the front and posterior aspects of the tooth, indicating its classification as a second molar. The process of wear just slightly touches the tooth. It is a narrow crowned tooth. All the principal cusps are well preserved and are easily recognizable. The tooth exhibits a prominent and well-developed

corrugated cingulum on both its anterior and posterior aspects. It can also be seen clearly on the gingival (gum) side of the tooth while only beginning to show signs of development on the lingual (tooth) side. The height-to-width index of the tooth shows that it is of brachyodont type.

The vertical height of the lingual cones, specifically the protocone and hypocone, is lower compared to that of the labial cones, namely the paracone and metacone. The anterior two cusps, i.e., protocone and paracone, are elongated transversely, which results in the formation of a concavo-convex ridge known as protoloph. The protoloph is comparatively high at its extremities while lower in the middle portion of it. Similarly, the posterior two cones, i.e., hypocone and metacone, are also elongated transversely and form a ridge that is similar to protoloph. This posterior ridge is named metaloph. It is also a concavo-convex structure.

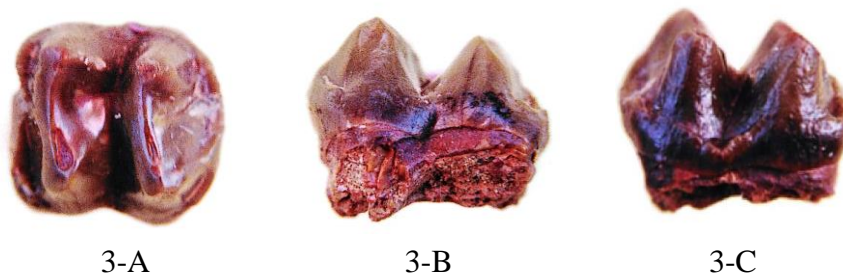


Fig. 3: Crown view (3-A), Lingual view (3-B), and Labial view (3-C) of G.C.P.C. No. 366/2001.

The protocone of the protoloph is more worn out than that of the paracone. A conspicuous dentinal islet is formed at its summit, which is elongated transversely. It is filled with a thin layer of cement. Similar dentinal islets are also present on the other three cones, i.e., paracone, hypocone, and metacone, of the tooth, but the dentinal islet of the protocone is the largest among all. A deep, shallow transverse valley is present between the protoloph and metaloph of the tooth. An oblique ridge

connects the hypocone with the posterior cingulum. Similarly, an oblique ridge is also observed in the central area of the anterior cingulum, which connects it to the anterior side of the protoloph. The anterior labial half of the protoloph and that of the anterior cingulum is strongly crenulated. All the principal cones of the tooth, i.e., protocone, paracone, hypocone, and metacone, are hook-shaped, i.e., they are elongated backwardly and outwardly.

Table 1. Measurements of upper dentition of *Listriodon pentapotamiae* (Pilgrim) and its comparison with the already recovered material

Specimen No.	Position	Length (mm)	Width (mm)	W/L Index
G.C.P.C. No. 383/2001	rP ²	13	6.5	50
*P.U.P.C. No. 4/86	rP ²	16	11.5	72
G.C.P.C. No. 366/2001	IM ²	21	20	95.2
*P.U.P.C. No. 226/69	IM ²	20	18.6	93
*P.M.N.H. No. 194/85	IM ²	21	21	100
*P.U.P.C. No. 219/69	IM ²	23	22.3	97

*Taken from (Ahmad, 1995)

DISCUSSION

The specimens G.C.P.C. No. 383/2001 and 366/2001 have been recovered from the Hasnot hamlet of District Jhelum of the Punjab province of Pakistan. The teeth show a multirouted and multicuspoid structure, which is a characteristic of class Mammalia (Romer, 1974). The taxonomic classification of Class Mammalia

encompasses two primary categories, namely oviparous mammals and placental mammals (Colbert, 1980). There is no evidence of egg-laying mammals living in the Tertiary of Asia (Darlington, 1957; De Beaufort, 1951). Both of the specimens under study seem to belong to some eutherian order on the basis of their size and morphology. The material under study shows herbivorous

build-up. Therefore, the material under study may either belong to the order Perissodactyla or Artiodactyla. However, neither the upper nor the lower teeth of any known Perissodactyla exhibit the bilophodont form of dentition. Therefore, the specimen under investigation must have come from some Artiodactyle.

The presence of lophodont teeth suggests that the specimens in question could potentially belong to the taxonomic groups of the genus *Listriodon*, *Tapir*, or *Deinotherium*. The morphology of both the specimens, i.e., a premolar and a molar, is typical of pigs. Within the family Suidae, it is noteworthy that only the Listriodonts possess a distinctive molar structure characterized by the presence of bilophodont cusps (Zittel, 1925), which is also exhibited by the material under study.

Romer (1962) postulated that *Listriodonts*, a type of lophodont pig, exhibited lower physical proportions and were historically prevalent in Europe, Africa, and Asia. Pilgrim (1926) described three distinct species belonging to the genus *Listriodon*, which were discovered in the Siwaliks region. These three species include *Listriodon guptai*, *Listriodon theobaldi*, and *Listriodon pentapotamiae*.

Listriodon theobaldi and *Listriodon pentapotamiae* can be differentiated based on the presence of oblique ridges that connect the cingula with the major ridges. In the species, *Listriodon theobaldi* these ridges are absent, while they are present in *Listriodon pentapotamiae*. The *Listriodon guptai* is characterized by its bunodont dentition, which sets it apart from the other two species. The species was then reclassified by Chen (1984) and added to the genus *Bunolistriodon*, which was originally established by Arambourg (1933) based on the aforementioned characteristics.

The discovery of *Listriodon pentapotamiae* was documented by Falconer (1868). The first type of dental material that he described was composed of the individual's very last premolars and molars. According to him, given that the teeth were discovered in the same location, it is possible that they belonged to the same animal. *Tapirus pentapotamiae* was the name given by Falconer (1868). After some years, Lydekker (1876) performed an in-depth study of the dental morphology and assigned it to the genus *Listriodon*. The species *Listriodon pentapotamiae* was discovered in the Lower Siwaliks and has been shown to

range all the way up to the Middle Siwaliks (Colbert, 1935).

CONCLUSION

The subject of investigation exhibits small grooves, which are distinctive features associated with the species *Listriodon pentapotamiae*. The differentiation between *Listriodon pentapotamiae* and *Bunolistriodon guptai* occurs on the basis of the presence or absence of these minor grooves, which are present in the species *Listriodon pentapotamiae* and are absent in the species *Bunolistriodon guptai*. In the molars, the anterior protoloph and posterior metaloph form transverse crests, which are twisted lingually. On the basis of the above-cited facts and comparisons made in the discussion, it seems possible that the present material may be referred to as the species *Listriodon pentapotamiae*.

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CONFLICT OF INTEREST

Authors declare there is no conflict of interest.

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