

New Collection of Fossil Remains of *Hyotherium pilgrimi* (Mammalia: Artiodactyla: Suidae), from Middle Miocene Rocks of Lower Siwaliks of Pakistan

Sadaf Aslam^{1,2*}, Abdul Majid Khan² and Muhammad Akhtar²

¹Centre for Undergraduate Studies, University of the Punjab, Lahore, Pakistan

²Department of Zoology, University of the Punjab, Lahore, Pakistan

ABSTRACT

The middle Miocene rocks of the Chinji Formation, Siwaliks Hills, Pakistan are well known for their rich and diverse vertebrate fossil assemblages. Here new suid fossil remains of the extinct species *Hyotherium pilgrimi* described. The known stratigraphic range of *Hyotherium* is about 14 to 11 million years. This species is closer to its smaller European relative *H. soemmeringi*. The studied material includes isolated premolars and molars. This paper provides new insights of morphology of an extinct species of the suid, *Hyotherium pilgrimi*.

Article Information

Received 11 July 2019

Revised 13 September 2019

Accepted 25 September 2019

Available online 11 December 2020

Authors' Contribution

SA conducted the research and wrote the manuscript. AMK provided lab facilities for the research. MA provided samples for this study.

Key words

Suidae, *Hyotherium*, Chinji, Middle miocene, Pakistan

INTRODUCTION

Suidae is a family of artiodactylan mammals including both extinct and extant species of boars, hogs and pigs. It is successful family having widely spread species in African and Eurasian continents. Oligocene epoch of Asia yielded suid fossils and during the Miocene their descendants in Europe.

The Siwalik beds are overall very fossiliferous and yielded a rich record of extinct suid ranging from middle Miocene to late Pliocene. Various paleontologists have made researches on Siwalik fossil suids. Lower Siwaliks of Pakistan has attracted the consideration of many palaeontologists because of abundant and well-preserved remains. Three genera of the family suidae i.e., *Listriodon*, *Conohyus*, and *Hyotherium* have been described from Lower Siwaliks, with varying ages from 14my to 11my. All levels of Chinji succession are rich for *Listriodon pentapotamiae* and *Conohyus sindiensis* but *Hyotherium pilgrimi* is rare. Orliac *et al.* (2010) described specimens of *Hyotherium* species along with *Sanitherium* and *Pecarichoerus* sp from the early Oligocene rocks of the Bugti Hills, Balochistan. Middle Miocene (Kamlial and Chinji strata) suids of Pakistan are comparable to that of Europe but distinct from that of Africa.

The fossil remains of Hyotheriinae described in this paper have been collected from the prominence of the Dhok Bun Amir Khatoon village (Lat. 32° 47' 26.4" N; Long. 72° 55' 35.7" E), Chinji (Lat. 32° 39' N; Long. 72° 22' E), Parrewala (Lat. 32° 41' N; Long. 72° 16' E), and the Lava village (Lat. 32° 64' N; Long. 71° 95' E) of the Chakwal district, Pakistan. The geology, stratigraphy, and fauna of these localities have already been described by many geologists and paleontologists.

MATERIALS AND METHODS

The specimens were collected during field trips in the Lower Siwaliks, either partly exposed or fully exposed. The fossil specimens are placed in the Dr. Abu Bakr Fossil Display and Research Center of the Department of Zoology, University of the Punjab, Lahore, Pakistan. The specimens are catalogued in two series i.e. the yearly catalogue number and the serial catalogue number. The upper figure represents the collection year, and the lower one represents the serial number of the respective specimen. Uppercase and lowercase letter represents upper and lower dentition respectively. Measurements of the specimens have been taken in millimeters (mm) with the caliper. Tooth length and breadth were measured at the cervix.

Abbreviations

PUPC, Punjab University Palaeontological Collection; M, upper molar; m, lower molar; L, length; W, width; M a, million years ago; mm, millimeters.

* Corresponding author: sadaf.hons@pu.edu.pk
0030-9923/2021/0001-0177 \$ 9.00/0
Copyright 2021 Zoological Society of Pakistan

SYSTEMATIC PALAEONTOLOGY

Order: ARTIODACTYLA Owen, 1848

Super family: SUOIDEA (Gray, 1821)

Family: SUIDAE Gray, 1821

Sub family: HYOTHERIINAE Cope 1888

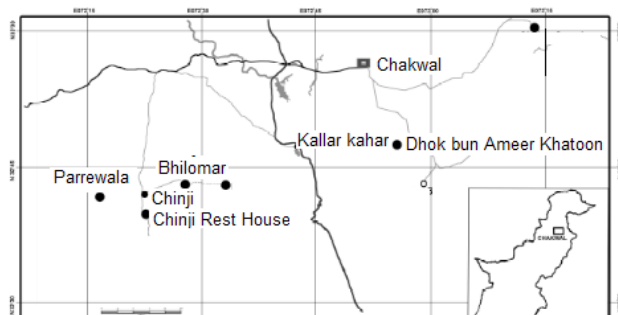
Genus: *Hyotherium* von MEYER, 1834**Type Species: *Hyotherium soemmeringi* von MEYER, 1834.***Generic diagnosis:* Same as in Pickford (1988)*Species Hyotherium pilgrimi* Pickford, 1988**Synonym list:** *Sus hysudricus*, *Proptamochoerus salinus*, *Dicoryphochoerus chisholmi*, *Dicoryphochoerus hydeni*, *Dicoryphochoerus instabilis*, *Proptamochoerus uliginosus* *Proptamochoerus salinus*, *Dicoryphochoerus hydeni*.**Specific diagnosis:** A species of *Hyotherium* similar to *H. soemmeringi* but approximately 20 % larger (Pickford, 1988).**Holotype:** GSI B681, crushed skull with right P⁴-M², left M¹⁻³.**Locality:** Chinji, Pakistan.**Horizon:** Chinji succession.**New Specimens observed**

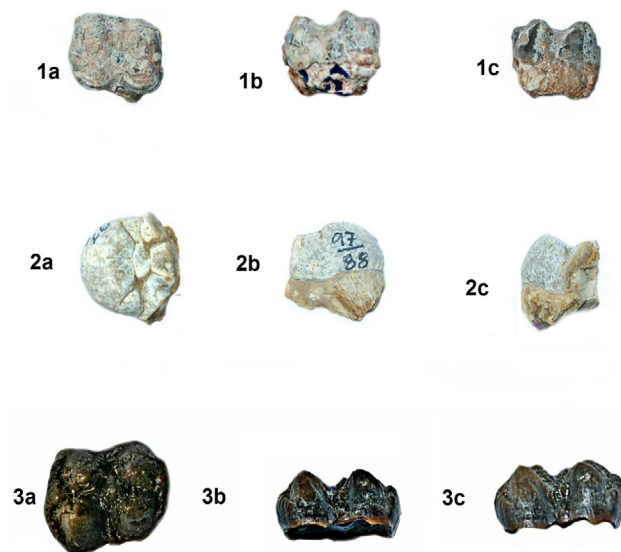
Fig. 1. Map showing different localities of Lower Siwaliks from where fossils have been collected.

Upper dentition

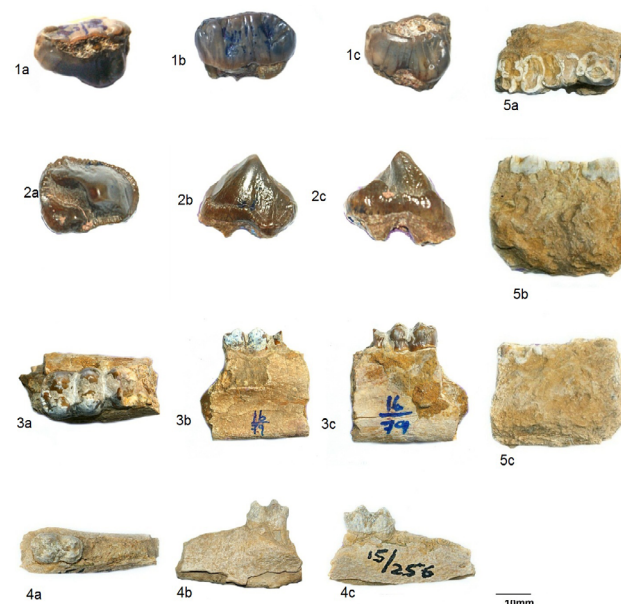
PUPC 97/88 (Fig. 1(2)), an isolated right M1 molar, collected from Lava, district Chakwal, Punjab province, Pakistan.

PUPC 95/6 (Fig. 2(3)), an isolated left M2 molar collected from Lava, district Chakwal, Punjab province, Pakistan.

PUPC 15/342 (Fig. 2(1)), an isolated left M1 molar collected from Dhok bun Ameer Khatoon, district Chakwal, Punjab province, Pakistan.

Fig. 2. *Hyotherium pilgrimi*. Upper Dentition. 1. PUPC 15/342, IM1. 2. PUPC 97/88, rM1. 3. PUPC 95/6, IM2. a. Occlusal view. b. Lingual view. c. Buccal view. Scale bar, 10mm.**Lower dentition**

PUPC 16/79, (Fig. 3(2)) an isolated right m2 collected from Dhok bun Ameer Khatoon, district Chakwal, Punjab province, Pakistan.

Fig. 3. *Hyotherium pilgrimi*. Lower Dentition. 1. PUPC 96/62, lp4. 2. PUPC 16/79, rm2. 3. PUPC 16/87, lp4. 4. PUPC 15/256, rm1. 5. PUPC 95/16, lp4-m2. a. Occlusal view. b. Lingual view. c. Buccal view. Scale bar, 10mm.

PUPC 96/62 (Fig. 3(1)), an isolated left p4 collected from Chinji, district Chakwal, Punjab province, Pakistan.

PUPC 95/16 (Fig. 3(5)), left mandibular ramus bearing p4-m2 collected from Parrewala, district Chakwal, Punjab province, Pakistan.

PUPC 15/256 (Fig. 3(4)) an isolated lower right first molar collected from Dhok bun Ameer Khatoon, district Chakwal, Punjab province, Pakistan.

PUPC 16/87 (Fig. 3(3)), an isolated lower left fourth premolar collected from Dhok bun Ameer Khatoon, district Chakwal, Punjab province, Pakistan.

Stratigraphic and geographic distribution of the present material

Chinji, Lava, Dhok bun Ameer Khatoon, Parrewala, district Chakwal, Punjab province, Pakistan. Lower Siwaliks; middle Miocene.

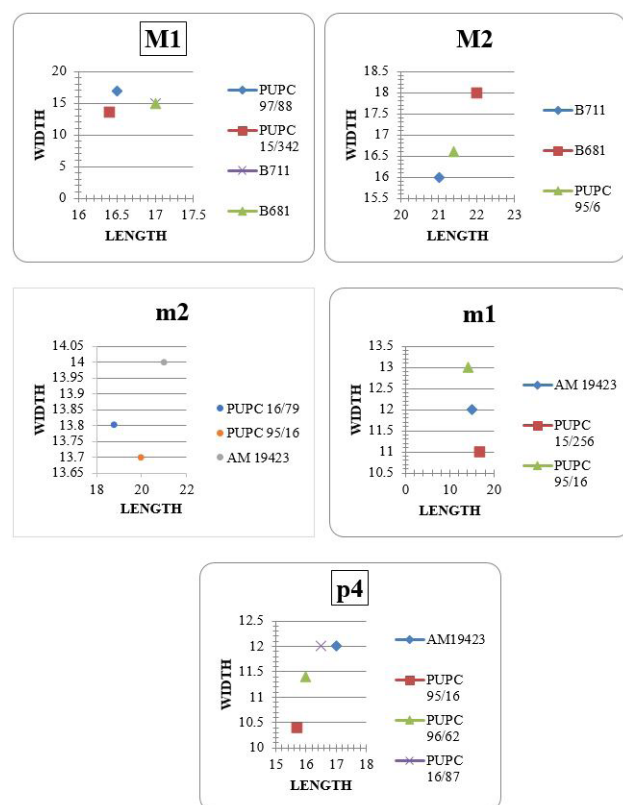


Fig. 4. Scatter chart showing comparative measurement of cheek teeth of *Hyotherium pilgrimi*. *Referred material taken from Pickford (1988).

Description

Upper dentition

M1 (Fig. 2(1, 2)) has single main cusp with many small mesial and distal cusplets. A small median accessory

cusp is also present. Lateral accessory cusps look to appear like median basal pillar. Enamel is moderately thick, rugose, and wrinkled. Broken root is visible.

M2 (Fig. 2(3)) is larger a version of first molar with four cusps. Mesial and distal small cusps and cingulum are also present. A central accessory cusp is present between the four cusps. Furchen are slightly deeper and broader. Cusps are moderately bunodont, somewhat similar to the cusps of *Conohyus*.

Table I. Comparative measurements (in mm) of cheek teeth referred to *Hyotherium pilgrimi*.

Specimen no	Position	Length (mm)	Width (mm)	Height (mm)
PUPC 97/88	M1	16.5	16.9	12
PUPC 16/79	m2	18.8	13.8	9.5
PUPC 16/87	p4	16.5	12	11.5
PUPC 96/62	p4	16.0	11.4	12.2
PUPC 95/06	M2	21.4	16.6	10.4
PUPC 15/342	M1	16.4	13.6	8.6
PUPC 95/16	p4	15.7	10.4	12.3
	m1	14.0	13.0	5.1
	m2	20.0	13.7	8.9
PUPC 15/256	m1	16.8	11.0	8.5
*AM 19423	m1	15	12	-
*AM 19423	m2	21	14	-
*B711	M1	17	15	-
*B681	M1	17	15	-
*B681	M2	22	18	-
*B711	M2	21	16	-
*AM19423	p4	17	12	-

*Referred material taken from Pickford, 1988.

Lower dentition

Fourth premolar (Fig. 3(1)) is a bifurcated tooth with prominent set off innenhugel. Mesial accessory cusp and cingulum are lower than distal accessory cusp and cingulum which is about half of the height of the main cusp.

PUPC 95/16 (Fig. 3(5)) is a broken mandibular corpus bearing p4 and m1-2. Lower fourth premolar is lophodont and in late stage of wear. Dentine is visible on top. Its enamel is thick.

Lower first molar (Fig. 3(4, 5)) is simple and has four main cusps. It is in early stage of wear. Distal accessory cusp is prominent. A moderately thick mesial cingulum is present anteriorly. A median basal pillar is present on buccal side. A median accessory cusp is present with wider

median cavity. Enamel is moderately thick and wrinkled. Roots of anterior premolars are preserved in mandibular ramus (PUPC15/256). Relatively shallow and wider furchen is present.

Second lower molar (Fig. 3(2)) is comparatively smaller than m2 with four principal cusps. The mesial cingulum is more developed. Sagittal valley is marked up by cement. Transverse valley is wider. Enamel is rugose. Median basal pillar is present at the entrance of median valley. Broken part of previous tooth is visible.

DISCUSSION AND COMPARISON

The studied specimens differ from other genera of suids by having moderately thick enamel, moderately deep furchen, bunodont molars with rather simpler talon/id, reduced or absent sagittal cusplet in P4. Therefore the specimens are placed in Hyotheriinae, an extinct subfamily of Suidae, because of rather simple bunodont dentition, P4 without accessory ridge in the sagittal groove and unexpanded talonid of m3.

Pickford (1988) described three genera of Hyotheriinae as *Gyotherium*, *Xenohyus* and *Chleuastochoerus*. Van der Made (1998) described three genera of Hyotheriinae as *Hyotherium*, *Xenohyus*, and *Aureliachoerus*. *Aureliachoerus*, a small suid, was recorded from late early Miocene of Europe. The Siwalik specimens differ from *Aureliachoerus* due to larger size. *Xenohyus* is an early Miocene suid from Europe with poor fossil record. Based on dental and cranial characters, it was assigned to Tayassuidae by Pickford and Morales (1989) and Pickford (1993). Whereas Van der Made (1989-1990) and Ginsburg (1980) treated it as a suid. It is considered as a distinctive form by Bouvrain and de Bonis (1999) and thus its systematic position remains unclear. Finally, Pickford (1988) erected *Hyotherium pilgrimi*.

The genus *Hyotherium* was not recognized in the Siwalik suid fauna since 1926, but actually it does occur there (Pickford, 1988). The specimens of *Hyotherium* from Siwaliks had been assigned to genus *Conohyus* by Lydekker (1887) and Pilgrim (1913). *Conohyus* and *Hyotherium* were considered as the same genus until *Conohyus* was erected as new genus by Pilgrim (1925, 1926) including the species *C. simmorensis*, *C. sindiensis*, and *C. indicus*. Other specimens of the genus *Hyotherium* were mistakenly assigned to the species *Dicoryphochoerus chisholmi*, *Propotamochoerus salinus*, *Sus hysudricus*, and *Dicoryphochoerus instabilis*. Pickford (1988) erected *Hyotherium* as a new genus based on peculiar skull characteristics. The genus *Hyotherium* is characterized by the very small or absent sagittal cusplets in P4, by shape of zygomatic arch, and by the moderate molar

enamel thickness. It differs from its European relative *H. soemmeringi* being 20% larger especially in its molar row. *Hyotherium* differs from *Propotamochoerus* and *Korynochoerus* in the presence of less developed sagittal cusplets in P4 by the shape of zygomatic arches and relatively thicker molar enamel (Pickford, 1988). According to Pickford (1988) development of sagittal cusplet on P4 is the main character differentiating Suinae from the Hyotheriinae. *Hyotherium* has no sagittal cusplets but during the evolutionary stages it developed precursors of sagittal cusplets from the enamel folding of labial cusps.

From China *H. schanwangense* is known from the late early Miocene (Liu *et al.*, 2002). It is much smaller than *H. pilgrimi*. Van der Made (1990) enlisted all described European Suoidea. It is suggested that *Hyotherium* evolved in Europe and then dispersed across Asia. *Hyotherium* is well known in Europe and includes the species *H. meisneri*, *H. soemmeringi*, and perhaps *H. major*. *Hyotherium meisneri* and *H. soemmeringi* have been reviewed in detail by Schmidt-Kittler (1971) and Hellmund (1991). *Hyotherium major* was synonymized with *H. meisneri* by Hellmund (1991) but because of its smaller size and the linear molar measurements, it is still considered as a valid species by Van der Made (1994). Liu *et al.* (2002) consider *H. meisneri* and *H. major* as belonging to the same species due to overlapping stratigraphic ranges.

Parachleuastochoerus, a small suid from Spain, is a close relative of hyotheriines and tetraconodontines, was formerly considered to be a hyotheriine by Golpe (1972) based upon morphology. Pickford (1981, 1988) attributed it to Tetraconodontinae. *Hyotherium pilgrimi* differs from other species of *Hyotherium* due to its larger size, small enamel ridge bringing out sagittal valley in P4, and longer talon of M3. According to Van der Made and Hussain (1989), the Indian and Eurasian suid fauna are very similar to each other.

CONCLUSION

This study provides new collection of *Hyotherium*, which is an extinct species of Suidae from middle Miocene rocks of Pakistan. This study will help to understand origin and dispersal of the Siwalik suids. This study also provides comparisons of siwalik *Hyotherium* with species of same genus from other areas of the world.

Statement of conflict of interest

The authors declare there is no conflict of interest.

REFERENCES

- Bouvrain G.L. and Bonis de. 1999. Suoidea du Miocene inferieur de Laugnac (Lot-et-Garonne, France). *Palaontol. Z.*, **73**: 167-178. <https://doi.org/10.1007/BF02987990>
- Ginsburg, L., 1980. *Xenohyus venitor* Suid nouveau (Mammalia, Artiodactyla) du Miocene Inférieur de France. *Geobios*, **13**: 861-877. [https://doi.org/10.1016/S0016-6995\(80\)80041-6](https://doi.org/10.1016/S0016-6995(80)80041-6)
- Golpe, J.M., 1972. Suiformes del Terciario español y sus yacimientos. *Paleontol. Evol.*, **2**:1-197.
- Hellmund, M., 1991. New and old finds of Suina (Artiodactyla, Mammalia) from Oligo-Miocene localities in Germany, Switzerland and France I. *Hyotherium meisneri* (Suidae) from the Lower Miocene of Ulm-Westtangente (Baden-Württemberg). *Stuttgart. Beitr. Naturk. B.*, **176** 69S: 1-69.
- Liu, L., Mikael, F. and Pickford, M., 2002. New fossil suidae from Shanwang, Shandong, China. *J. Verteb. Paleontol.*, pp. 152-163. [https://doi.org/10.1671/0272-4634\(2002\)022\[0152:NFSFSS\]2.0.CO;2](https://doi.org/10.1671/0272-4634(2002)022[0152:NFSFSS]2.0.CO;2)
- Lydekker. 1887. *Catalogue of the fossil Mammalia in the British Museum* Pt. 5 London. <https://doi.org/10.1017/S0016756800182640>
- Orliac, J.M., Antoine, P.O., Roohi, G. and Welcomme, J.L., 2010. Suoidea (Mammalia, Cetartiodactyla) from the early Oligocene of the Bugti hills, Balochistan, Pakistan. *J. Verteb. Paleontol.*, **30**: 1300. 167-178. <https://doi.org/10.1080/02724634.2010.483554>
- Palmer, D., 1999. *The Marshall illustrated encyclopedia of dinosaurs and prehistoric animals*. Marshall Editions, London. 269.
- Pickford, M. and Morales, J., 2003. New Listriodontinae (Mammalia, Suidae) from Europe and a review of listriodont evolution, biostratigraphy and biogeography. *Geodiversitas*, **25**: 347-404.
- Pickford, M., 1981. Parachleuastochoerus (Mammalia, Suidae). *Estud. Geol.*, **37**: 313-320.
- Pickford, M., 1988. Revision of the Miocene Suidae of the Indian subcontinent. *Munch. Geowissenschaft. Abhandl., Geol. Palaontol., Reihe. A.*, **12**: 22-23.
- Pickford, M. and Morales, J., 1989. On the Tayassuid affinities of *Xenohyus* Ginsburg, 1980, and the description of new fossils from Spain. *Estudios Geo.*, **45**: 233-237.
- Pickford, M., 1993. Old world suoid systematics, phylogeny, biogeography and biostratigraphy. *Paleontol. Evol.*, **26-27**: 237-269.
- Pilgrim, G.E., 1913. Correction in generic nomenclature of Bugti fossil mammals. *Rec. Geol. Surv. India*, **43**: 75-76.
- Pilgrim, G.E., 1925. *Presidential address to the geological section of the 12th Indian Science Congress. Proc. 12th Indian Sci. Congr.* pp. 200-218.
- Pilgrim, G.E., 1926. The fossil suidae of India. *Mem. Geol. Surv. India Palaeont. Indica*, **8**: 1-68.
- Schmidt-Kittler, N., 1971. Die obermiozäne Fossilagerstätte Sandelzhausen Suidae, Artiodactyla, Mammalia. *Mitteil. Bayer. Staatssamml. Paliontol. hist. Geol.*, **11**:129-170.
- Van der Made, J. and Hussain, S.T., 1989. *Microstonyx major* (Suidae, Artiodactyla) from the type area of the Nagri Formation, Siwalik Group, Pakistan. *Estud. Geol.*, **45**: 409- 416. <https://doi.org/10.3989/egzol.89455-6512>
- Van der Made, J., 1990. A range-chart for European Suidae and Tayassuidae. *Paleontol. Evol.*, **23**: 99-104.
- Van der Made, J., 1994. Suoidea from the lower Miocene of Cetina de Aragón (Spain). *Rev. Espan. Paleontol.*, **91**: 1-23.
- Van der Made, J., 1998. *Aureliachoerus* from Oberdorf and other Aragonian pigs from Styria. *Annls Naturhist. Mus. Wien*, **99A**: 225-277.