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A Morphometric Analysis of Suid Remains of the genus *Conohyus* from the Siwalik Beds of District Jhelum, Punjab, Pakistan

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ABSTRACT: *The current fresh Suid dental material was gathered from Pakistan's Siwalik hills, which are located in Punjab and stretch into Northern Pakistan. There have been reports of fossils being found at sites belonging to this genus in the Hasnot hamlet, which is situated in the Punjab province of Pakistan in the district Jhelum region. These particular examples are representatives of a small suid genus called Conohyus, which is commonly found in the Siwalik Mountains. The material that has been analyzed has provided a significant amount of insight into the underlying dentition that is typical of this genus. The teeth of the genus Conohyus are a little more advanced than the condition found in the genus Palaeochoerus.*

Keyword: Artiodactyla, *Conohyus*, Hasnot, Siwalik hills, Suidae

INTRODUCTION

The Siwalik region in Northern Punjab, as well as other locations within these hills, is home to a large population of suids, which are categorized as artiodactyl mammals. Numerous researchers began excavating several different areas on the hills of the subcontinent in the nineteenth century and continued doing so to the present day. During their excavations, they discovered a significant quantity of fossils. For example, among the well-known paleontological researchers who had undertaken research in this region include Falconer and Murchison (1868),

Lydekker (1884), Stehlin (1899), Pilgrim (1910, 1926), Colbert (1935, 1980), Pickford (1988), Made (1996, 1998), Pickford and Morales (2003), and Batool et al. (2015). All of these researchers have conducted their studies in this region. Despite this, there have been a significant number of other paleontological experts who have carried out research in this part of the world, including Draz et al. (2020), Waseem et al. (2021), Raza et al. (2022), Samiullah et al. (2022), Nadeem (2023, 2023a, 2023b). Thousands of years ago, the family Suidae was highly prevalent in the Siwalik hills of the Indo-Pakistan region. At that time, many genera were present as well. This was the result of the family being able to generate a large progeny (Pickford and Obada, 2016; Spassov et al., 2018; Mors et al., 2019).

On the other hand, while numerous species from that era have been repeatedly found in fossil records, certain species have a considerably lower number of representative fossils. As a consequence of this fact, the excavation of any new material of these old species is supposed to be of the utmost importance for the purpose of acquiring adequate knowledge of the role that they performed in evolutionary history and what is their specific position in the course of the development of this genus. The vicinity of Hasnot encompasses five distinct constituent formations, each of which may be discerned from the rest. The Kamlial, Chinji, Nagri, and Dhok Pathan formations are also present, alongside the Soan Formation (Ghaffar and Akhtar, 2012). The Siwaliks in the region of Jhelum were going to be the focus of an investigation that was going to be carried out in order to locate some fossils and identify them to the level of genus or species.

The current exploration work targeted the Nagri formation of the area. The Siwalik beds were divided into three levels, i.e., the Lower Siwaliks (Kamlial and Chinji Formations), the Middle Siwaliks (Nagri and Dhok Pathan Formations), and the Upper Siwaliks (Pinjor, Boulder Conglomerates and Tatrot Formations), by Pilgrim (1913). The targeted Nagri Formation (8-10 million years of age) belonged to the Middle Siwaliks (approximately 1800 meters thick), and it is Miocene in age (Pilgrim, 1910, 1910a, 1913; Jacobs, 1978). Jacobs (1978) also correlates the Siwalik's Nagri Formation with the Valesian Formation of Europe. The Nagri Formation is composed of red clay with included nodules. The Nagri outcrops exhibit cyclic alternation of

sandstone with subordinate clay and conglomerates. The sandstone is grey, greenish-grey, light grey, and medium to coarse-grained. In some places, this sandstone is bluish-grey, calcareous, and poorly cemented. Subordinate clay is sandy, silty, brown, chocolate brown, reddish grey, or pale orange in appearance, while the Conglomerates consist of pebbles of igneous rocks and Eocene limestone.

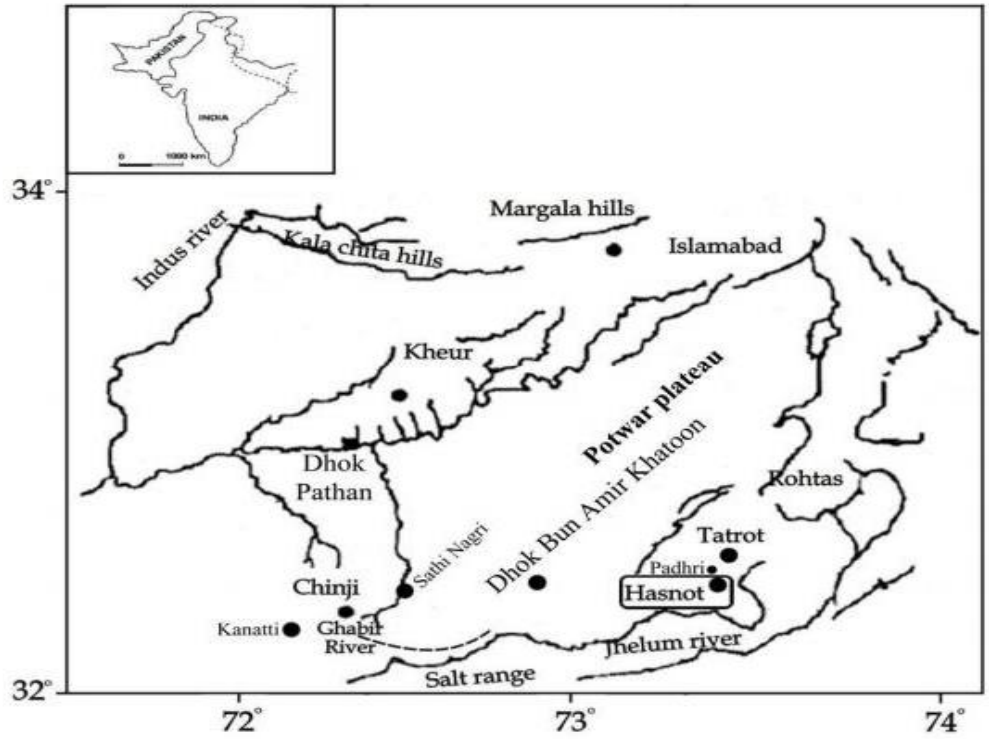

Fig. 1. A map of the Potwar Plateau in Punjab and northern Pakistan shows the research region (Barry et al., 2002)

MATERIALS AND METHODS

The material under study was collected from the Nagri Formation located in Punjab, Pakistan, in the general location of the Hasnot (Lat. 32.824167 and Long. 73.131111) hamlet of district Jhelum. It was found partially exposed and hence recovered carefully with the help of paleontological tools, including a light hammer, chisels, sharp needles, brushes, etc. Currently, the collected material is deposited in the Department of Zoology's paleontological collections at Government College, now known as GC University, situated in Lahore, Pakistan. Millimeters (mm) were used as the unit of measurement for the measurements that were taken with a

Vernier caliper from the metric system. An examination is made of the morphometric characteristics of the specimen that is being investigated. The specimens have a serial catalog number, the denominator of which is the year of collection and the numerator of which is the specimen's serial number. For example, A Government College Palaeontological Collection Number 377/2001 is also abbreviated as G.C.P.C. No. 377/2001. Both the terminology and the techniques of the measurement of recovered material are based on a reference to Pickford (1988), which serves as the foundation for both of these aspects. Different specimens present in the palaeontological collection of the University of the Punjab, Lahore, were also examined along with the literature review of the previously described specimens like the "Transactions of the American Philosophical Society by Colbert (1935)".

Abbreviations used: The following abbreviations are used in the manuscript;

G.C.P.C. Government College Palaeontological Collection.

P.U.P.C. Punjab University Palaeontological Collection.

Ind. Mus. Indian Museum, Calcutta.

RESULTS

Systematic Account The systematic palaeontological account of the excavated sample is as under;

Order Artiodactyla Owen, 1848

Family Suidae Gray, 1821

Genus *Conohyus* Pilgrim, 1926

Species *C. sindiensis* (Lydekker, 1884) Pilgrim, 1926

The specimen under investigation

G.C.P.C. No. 377/2001, is an isolated upper second molar of the right side recovered from Hasnot, located in District Jhelum of Punjab, Pakistan.

DESCRIPTION

The morphometric details of the recovered specimen under study are as follows:

Specimen 377/2001 (Second Molar) (Fig. 2).

The isolated right upper second molar G.C.P.C. 377/2001 was taken from Hasnot, district Jhelum, Punjab, Pakistan. It may be a second molar because there is a noticeable pressure mark on both the front and back sides of it. The specimen is virtually square with a low-crowned structure (Table 1). The specimen appears rough from its lingual surface, which may be the result of the weathering process; the tooth is well preserved and covered with a thick layer

of corrugated enamel. The enamel layer is shining all around the tooth, with the exception of the lingual side. Additionally, there is a delicate layer of cement that can be found on the posterolingual sides of the tooth. The ratio of its height to width index indicates that it is a type of tooth that is classified as a bunodont-brachyodont relationship. On the anterior as well as posterior sides of the tooth, a robust multi tuberculated cingulum is present. On the lingual side, it is just slightly weak, and on the labial side, it is virtually entirely no longer there. The crown of the tooth is relatively thin or narrow.

Crown view **Labial view** **Lingual view**

Fig. 2. Right upper molar of *Conohyus sindiensis* recovered from Hasnot

Every single one of the four major cusps is clearly defined. In terms of vertical height, the lingual cones, which are referred to as hypocone and protocone, are lower than the labial cones, which are recognized as paracone and metacone. The front portion of the tooth's protocone has been worn down to a significant degree, and as a result, a small landmass has emerged on the front side of the protocone, revealing the dentine. The suid grooves on the front, back, and middle are just starting to form. The anterior accessory conule and the protocone are linked through a narrow channel that connects the two structures. The tooth's paracone has a significant amount of wear and tear. There is a little dentinal channel that is present, and it is connected to the anterior accessory conule. It has a very thin coating of cement that lies inside of it. The three characteristic suid grooves, which are the anterior, the posterior, and the middle or median suid groove, are present and clearly observable. On the anterior aspect of the main anterior cusps, is where you will find the anterior auxiliary conule. This conule is largely worn out and has almost reached the same level as the anterior cingulum. In the middle of the crown, there is a

median accessory conule that has become flattened lingually and labially. This occurs because the crown has been worn down to a significant degree. An incipient dentine is exposed in the midst of the conule, which results in the formation of a tiny dentinal islet.

Additionally, the hypocone (a posterior cone) of the excavated tooth is largely worn out and has a vertically low height. Clearly discernible are the three characteristic suid grooves that are distinctive of the suid. A dentinal islet can be found on the upper side of the hypocone, and it is within this islet that a little dentinal valley is produced. Additionally, there is a small cover of cement that is observable lingually. A significant amount of wear and tear has also been placed on the tooth's metacone, and the labial side of the tooth is primarily injured. Notable suid grooves consist of three distinct grooves that are immediately identifiable.

At the foundation of the two principal cones, i.e., para and metacone, the substantial basal pillars on the labial side serve as a marker for the entrance of the transverse valley through the tooth. Additionally, there is a sturdy foundational structure on the inner side of the tooth, positioned near the beginning of the transverse valley. In comparison to the labial side, the lingual side of the tooth has a valley that is generally more expansive. We can also make out a valley that runs longitudinally. There is also a posterior auxiliary conule located on the back side of the tooth, which is connected to the posterior cingulum. This connects the two structures. As a result of prolonged wear, it has nearly become flattened.

Table 1: Measurements of upper dentition of *Conohyus sindiensis* (Lydekker) and its comparison with the already recovered material.

Specimen No.	Position	Length (mm)	Width (mm)	W/L Index
G.C.P.C. No. 377/2001	M^2	18.0	15.0	83.3
P.U.P.C. No. 443/69	M^2	17.0***	16.2***	95
Ind. Mus. B. 536	M^2	16.5*	16.7*	101
Ind. Mus. B. 102	M^2	16.8**	18.8**	112
Ind. Mus. B. 101	M^2	16.2**	15.4**	95

* Taken from illustrations made by Pilgrim (1926)
** Taken from Lydekker (1884)
***Taken from Ahmad (1995)

DISCUSSION

The specimen is collected from the middle Siwalik beds of the outskirts of Hasnot, located in the district Jhelum of the Punjab province, Pakistan. Since it has been collected from the middle siwaliks where prototheres and metatheres are absent as fossils. Lydekker (1876, 1884) identified a number of solitary molars and maxillary fragments as belonging to the genus *Hyotherium*. Lydekker, op. cit., pl. XII, figures 7-8 and 10-11 demonstrate that some of these specimens have primary cusps that are rounded and simple, and they have incipient grooves and median accessory tubercles. All of these characteristics characterize the molar teeth that belong to the genus Conohyus. *Conohyus sindiensis* was initially given the name *Hyotherium sindiensis* by Lydekker (1884). However, Pilgrim (1926) later changed the name of the species to *Conohyus sindiensis* and transferred it to the appropriate genus. Therefore, in this manner, Pilgrim (1926) establishes a new genus of organisms belonging to the family Suidae.

It is the isolated teeth, remnants of maxilla, and mandibles that are the most common way that *Conohyus sindiensis* is recognized. The differentiation was established based on the morphology of the summit of the 4th maxillary premolar (P^4), which is conical in shape in the *Conohyus* genus but has two cusps in other genera. In the genus *Conohyus*, the upper third and fourth premolars (P^3 and P^4) are larger relative to the molars. However, in other species of the same subfamily, these premolars are of average size.

An indication that the tooth in question does not belong to any carnivorous species but rather to a herbivorous mammal is the rounded shape of the cones that are present in the specimen in question. It is determined that the tooth belongs to the family Suidae of Gray (1821) because of the dense clustering of conelets. Five subfamilies fall under the umbrella of the Suidae family, as stated by Simpson (1945). Hyotheriinae, Listriodontinae, Tetraconodontinae, Sanitheriinae, and Suinae are the subfamilies that fall under this category. Due to the fact that the characteristics of the tooth belonging to the specimen under investigation are more closely related to the Tetraconodontinae subfamily, the specimen has been classified as belonging to this subfamily. Within the Tetracocodontinae subfamily, three genera can be found: *Tetraconodon, Sivachoerus,* and *Conohyus*. In order to make a comparison with the specimen that is

being investigated, the first two genera are too large.

The *Conohyus sindiensis*, the *Conohyus chinjiensis*, and the *Conohyus indicus* are the three species that are currently classified as belonging to this genus. *Conohyus sindiensis* and *Conohyus indicus* are the two species that make up the majority of the Siwalik material that belongs to the genus *Conohyus*. *Conohyus sindiensis* is a tiny species that belongs to the genus and has a cingulum that develops on a weekly basis. There is a massive species of the genus known as *Conohyus indicus*, which Lydekker (1884) described as spanning from the Nagri to the Dhok Pathan formation. *Hyaenodon indicum* was the name that Lydekker called it when it was first described. It was initially identified by Pilgrim (1910) as a tooth belonging to the *Hyotherium*; however, in 1926, he moved the species to the *Conohyus* genus due to his discovery. Although there is a substantial similarity between the dental material of *Conohyus sindiensis* and that of *Conohyus chinjiensis*, it is incredibly challenging to differentiate between the two species.

According to Colbert (1935), the Chinji Formation is home to a species of the genus known as *Conohyus chinjiensis*, which is a relatively small species. It is discovered that it is identical to the species *Conohyus sindiensis*. When it comes to distinguishing between *Conohyus sindiensis* and *Conohyus chinjiensis*, the characteristics that Pilgrim (1926) cites as distinguishing characteristics are questionable. According to Pilgrim (1926), the talon of the third molar is quite variable in every species of the suid. Therefore, in this specimen, the talon is relatively short, while the breadth of the tooth is relatively large.

CONCLUSION

The tooth under study is from Hasnot, which is included in the Middle Siwaliks and mainly comprised of Nagri and Dhokpatan Formations. It is quite a short, low-crowned tooth with a simple median accessory conule. All these are the typical characteristics of the genus *Conohyus sindiensis.* On the basis of comparisons and other details of the excavated material with the previously described material, it is concluded that the material belongs to the species *Conohyus sindiensis*.

AUTHORS' CONTRIBUTION

Amir Nadeem Conceived the idea, conducted field surveys, identified the excavated material, wrote the original manuscript, and reviewed and edited it for final submission.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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