A new iodactylid pterosaur from western Liaoning

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Abstract: A new iodactylid pterosaur, Longchengpterus zhaoi gen. et sp. nov., is erected, based on an incomplete skeleton with a part of skull from the Jiufotang Formation at Chaoyang, western Liaoning. The skull and tooth morphologies indicate that Longchengpterus zhaoi is more closely related to Istiodactylus latidens than to other pterosaurs. Longchengpterus zhaoi is the only iodactylid pterosaur from the Jiufotang Formation of western Liaoning. The family Istiodactylidae originally had only a genus and species, which was found in the Early Cretaceous strata of Britain. The discovery of the new Early Cretaceous iodactylid from western Liaoning not only expands its geographical distribution but also proves that western Liaoning is an important region for the iodactylid radiation and diversity during the Late Jurassic to Early Cretaceous. It has great implications for the study of the origin and evolution of pterosaurs.

Key words: Longchengpterus; Istiodactylidae; Jiufotang Formation; Early Cretaceous; western Liaoning

The Jiufotang Formation from the western part of Liaoning Province is one of the most important fossiliferous continental deposits known so far. At present, seven genera and eight species of pterosaurs have been reported from the Jiufotang Formation. These include two species of Sinopterus: S. dongi [13] and S. gui [14]; Jidapterus edentus, whose family status is uncertain [8], an Anhanguerid Liaoningopterus gui [14], Chaoyangopterus zhangi, which was attributed to Nyctosauridae by Wang and Zhou [15], and a ctenochasmatid Liaoxipterus brachyognathus [16], an azhdarchid Eoazharchus [17] and Huaxiapterus jii [18]. The new specimen is distinguished from the above-mentioned toothless forms such as Sinopterus, Huaxiapterus, Jidapterus, Chaoyangopterus and Eoazharchus in having teeth in the upper and lower jaws. It is different from the toothed Liaoningopterus and Liaoxipterus in that...
the teeth are different in size in *Liaoningopterus* and *Liaosipterus*, while the teeth in the new specimen are nearly the same in size. The tooth morphologies of the new specimen indicate that it represents a new istiodactyloid pterosaur from the Jiufotang Formation.

**Systematic Paleontology**

*Order Pterosauria Kaup, 1834*<sup>6</sup>

*Superfamily Ornithocheiroidea Seeley, 1891*<sup>14</sup>

*Family Istiodactyloidea Howse, Milner and Martill, 2001*<sup>15</sup>

*Genus Longchengopterus gen. nov.*

**Etymology:** Longcheng, the ancient name of Chaoyang City; -pterus, Greek, the suffix of pterosaur. The generic name implies that the new pterosaur is found from Chaoyang City, Liaoning Province.

**Diagnosis:** as for the only species.

*Longchengopterus zhaoi* sp. nov.

**Etymology:** The species (Fig.1) is named in honor of President Zhao Dayu of Shenyang Normal University, who sponsored to set up the Western Liaoning Institute of Mesozoic Paleontology.

**Holotype:** A partial skeleton with an incomplete skull (LPM 00023). Specimen stored in Liaoning Paleontological Museum at Western Liaoning Institute of Mesozoic Paleontology, Shenyang Normal University.

**Type locality and horizon:** Yanjujua village, Dapingfang town, Chaoyang. Upper part of the Jiufotang Formation.

**Diagnosis:** A new Istiodactyloid pterosaur, it differs from *Istiodactylus laidensis* in that relatively small size, and the anterior end of the lower jaw is slightly expanded. There are twelve teeth on each side of the lower jaw. The ratio of mandibular symphys length to the lower jaw length is approximately 0.32.

**Description:** Most of the skeletons are preserved, and the measurements of the specimen are in table 1. The lower jaw is almost completely preserved, and the skull is crushed and the detailed structure of the posterior portion of the skull is not clear. The skull is relatively low and elongate. The nasoantorbital opening is triangle in lateral view and occupied much of the snout. The position of quadrate relative to the ventral margin of the skull is inclined backwards. The teeth are displaced and sparsely distributed near the anterior part of the upper jaw, and the exact tooth number of the upper jaw is unclear. The lower jaw is exposed its dorsal side. The mandibular symphys is very short. There are twelve teeth on the right dentary. The tooth has sharp tip and tooth root with expanded middle portion. Thus the tooth is spindle-like in lateral view. All teeth are almost the same in size. The tip of the tooth is slightly curved medially.

Four cervical vertebrae are preserved. The short one with a high neural spine behind the posterior end of the skull should be an axis. The remaining three are third, fourth and fifth cervicals. The second cervical vertebra is exposed its right lateral side, the fourth one is exposed in ventral side and the fifth is exposed its dorsal side. There is a pleurocoel in the third cervical vertebra. The ventral surface of the fourth cervical vertebra is smooth and the neural spine is very low in the fifth dorsal vertebra.

The scapula and the coracoid are fused. The coracoid is longer than the scapula. The coracoid is straight with a same diameter along its shaft. The proximal end of the scapula is expanded.

The humerus is almost well-preserved. Both ends are slightly expanded. The deltopectoral crest is short. There is no pneumatic foramen on the humerus.

The ulna and radius: The radius is slightly longer than ulna. The diameter of the radius is less than half that of the ulna.

Carpals and metacarpals: The carpals are strongly displaced. The exact shapes of them are not clear. Metacarpal IV is slightly longer than the wing phalange 1. A short slender bone is located near the proximal end of the wing phalange 1. It is flattened with sharp end. This bone should

Table 1 Measurements of *Longchengopterus zhaoi* (LPM 00023) gen.et sp. nov

<table>
<thead>
<tr>
<th>Elements</th>
<th>length</th>
<th>mid-shaft width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skull (from the posterior margin of the squamosal to the anterior tip of the upper jaw)</td>
<td>262</td>
<td>—</td>
</tr>
<tr>
<td>Lower jaw (from the end of the retroarticular process to the anterior end of the dentary)</td>
<td>220</td>
<td>—</td>
</tr>
<tr>
<td>Scapula</td>
<td>44.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Coracoid</td>
<td>58</td>
<td>8.7</td>
</tr>
<tr>
<td>Humerus</td>
<td>88</td>
<td>16</td>
</tr>
<tr>
<td>Ulna</td>
<td>147</td>
<td>14</td>
</tr>
<tr>
<td>Radius</td>
<td>148</td>
<td>6.6</td>
</tr>
<tr>
<td>Pteroid</td>
<td>60</td>
<td>3.4</td>
</tr>
<tr>
<td>Metacarpal IV</td>
<td>100</td>
<td>14</td>
</tr>
<tr>
<td>Wp1/d4</td>
<td>196</td>
<td>13</td>
</tr>
<tr>
<td>Wp2/d4</td>
<td>154</td>
<td>8.7</td>
</tr>
<tr>
<td>Wp3/d4</td>
<td>119</td>
<td>6.6</td>
</tr>
<tr>
<td>Femur</td>
<td>91(est.)</td>
<td>2.3</td>
</tr>
</tbody>
</table>
Fig.1 Photo of *Longbojiangopterus* *haoi* (LPM 00023), gen. et sp. nov. (scale in cm)
be one of the three metacarpals. The metacarpals I–III are not articulated with carpal.

The wing phalanx 1 is the longest among the wing phalanges. It is thicker than the remaining wing phalanges although it may slightly exaggerate due to its preservation. The proximal articulation of the first wing phalanx has a fused extensor tendon process. This indicates that this animal is an adult individual. There is pneumatic foramen in the proximal end of the wing phalanx 1. Both ends of the wing phalanx 2 are slightly eroded. The wing phalanx 3 is shorter and slenderer than wing phalanges 1 and 2. The wing phalanx 4 is not preserved.

The pelvic girdle and hindlimb: The pelvic girdle is not well-preserved and only a small portion of ilium is preserved, but it is uninformative. The most of the anterior portion of the femur is preserved. It has a clear neck region. The distal end of the femur is covered by the humerus, thus its detailed structure is not clear.

Discussion: Longchengpterus is assigned to Istiodactyliidae, based on the following characters: Diameter of the radius is less than half that of the ulna[3], unusually extensive nasomaxillary opening occupies much of the snout, teeth labiolingually compressed with sharply pointed crowns[11,13,14]. Istiodactyliidae includes two genus Istiodactylus[6] and Longchengpterus gen. nov. Istiodactylus found from England of the Early Cretaceous, it indicated that this pterosaur distributed in Europe—Asia areas. Which has important signification for studying the origin of the pterosaur. More than ten species of others pterosaur of the Late Jurassic to Early Cretaceous of western Liaoning have been reported. These materials indicate that western Liaoning area is an evolution center of the pterosaur during Early Cretaceous.

The skull and the tooth morphologies of Longchengpterus and Istiodactylus are similar and the tooth numbers in the upper and lower jaws of both genera are the same. Longchengpterus is different from Istiodactylus in that the anterior end of the snout is narrow, while it is round and broad in Istiodactylus. Longchengpterus is the first Istiodactyliid pterosaur found from the Jiufotang Formation.

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References:


