= Abelisauridae =

Abelisauridae (meaning " Abel 's lizards ") is a family (or clade) of ceratosaurian theropod dinosaurs . Abelisaurids thrived during the Cretaceous Period , on the ancient southern supercontinent of Gondwana , and today their fossil remains are found on the modern continents of Africa and South America , as well as on the Indian subcontinent and the island of Madagascar . Reports based on isolated teeth show the occurrence in the Late Jurassic of Portugal , and the confirmed existence of European Abelisaurids comes from the Late Cretaceous of France with Arcovenator . Abelisaurids first appear in the fossil record of the early middle Jurassic period , and at least one species (Majungasaurus) survived until the end of the Mesozoic era 66 million years ago .

Like most theropods , abelisaurids were carnivorous bipeds . They were characterized by stocky hindlimbs and extensive ornamentation of the skull bones , with grooves and pits . In many abelisaurids , like Carnotaurus , the forelimbs are vestigial , the skull is shorter and bony crests grows above the eyes . Most of the known abelisaurids would have been between 5 and 9 meters (17 to 30 ft) in length , from snout to tip of tail , with a new and as yet unnamed specimen from northwestern Turkana in Kenya , Africa reaching a possible length of 11 ? 12 meters (36 to 39 feet) . Before becoming well known , fragmentary abelisaurid remains were occasionally misidentified as possible South American tyrannosaurids .

= = Description = =

Abelisaurid hindlimbs were more typical of ceratosaurs , with the astragalus and calcaneum (upper ankle bones) fused to each other and to the tibia , forming a tibiotarsus . The tibia was shorter than the femur , giving the hindlimb stocky proportions . There were three functional digits on the foot (the second , third , and fourth) , while the first digit , or hallux , did not contact the ground .

= = = Skull = = =

Although skull proportions varied , abelisaurid skulls were generally very tall and very short in length . In Carnotaurus , for example , the skull was nearly as tall as it was long . The premaxilla in abelisaurids was very tall , so the front of the snout was blunt , not tapered as seen in many other theropods .

Two skull bones , the lacrimal and postorbital bones , projected into the eye socket from the front and back , nearly dividing it into two compartments . The eye would have been located in the upper compartment , which was tilted slightly outwards in Carnotaurus , perhaps providing some degree of binocular vision . The lacrimal and postorbital also met above the eye socket , to form a ridge or brow above the eye .

Sculpturing is seen on many of the skull bones , in the form of long grooves , pits and protrusions . Like other ceratosaurs , the frontal bones of the skull roof were fused together . Carnotaurines commonly had bony projections from the skull . Carnotaurus had two pronounced horns , projecting outward above the eyes , while its close relative Aucasaurus had smaller projections in the same area . Majungasaurus and Rajasaurus had a single bony horn or dome , projecting upwards from the skull . These projections , like the horns of many modern animals , might have been displayed for species recognition or intimidation . In Arcovenator , the dorsal margin of the postorbital (and probably also the lacrimal) is thickened dorsolaterally , forming a strong and rugose bony brow ridge rising above the level of the skull roof . Maybe this rugose brow ridge supported a keratinous or scaly structure for displays .

= = = Forelimbs and hands = = =

Data for the abelisaurid forelimbs are known from Eoabelisaurus and the carnotaurines Aucasaurus , Carnotaurus and Majungasaurus . All had small forelimbs which seem to have been vestigial . The

bones of the forearm (radius and ulna) were extremely short , only 25 % of the length of the upper arm (humerus) in Carnotaurus and 33 % in Aucasaurus . The entire arm was held straight , and the elbow joint was immobile .

As is typical for ceratosaurs , the abelisaurid hand had four basic digits . However , it is there that any similarity ends . No wrist bones existed , with the four palm bones (metacarpals) attaching directly to the forearm . There were no finger bones on the first or fourth digits , only one on the second digit and two on the third digit . These two external fingers were extremely short and immobile . Manual claws were very small in Eoabelisaurus , and totally absent in carnotaurines .

More primitive relatives such as Noasaurus and Ceratosaurus had longer , mobile arms with fingers and claws . Paleobiologist Alexander O. Vargas have suggested a major reason for the evolution towards vestigial forelimbs in the group was because of a genetic defect ; the loss of function in HOXA11 and HOXD11 , two genes which regulate the forelimbs ' development .

= = Distribution = =

Abelisauroids are typically regarded as a Cretaceous group , though the earliest abelisaurid remains are known from the Middle Jurassic of Argentina (classified as the species Eoabelisaurus mefi) and possibly Madagascar (fragmentary remains of an unnamed species) ; a possible abelisaurid remains (an isolated left tibia , right femur and right tibia) were also discovered in Late Jurassic Tendaguru Beds in Tanzania . Abelisaurid remains are mainly known in the southern continents , which once made up the supercontinent of Gondwana . When first described in 1985 , only Carnotaurus and Abelisaurus were known , both from the Late Cretaceous of South America . Abelisaurids were then located in Late Cretaceous India (Indosuchus and Rajasaurus) and Madagascar (Majungasaurus) , which were closely connected for much of the Cretaceous . It was thought that the absence of abelisaurids from continental Africa indicated that the group evolved after the separation of Africa from Gondwana , around 100 million years ago . However , the discovery of Rugops and other abelisaurid material from the middle of the Cretaceous in northern Africa disproved this hypothesis . Mid @-@ Cretaceous abelisaurids are now known from South America as well , showing that the group existed prior to the breakup of Gondwana . In 2014 , the description of Arcovenator escotae from southern France provided the first indisputable evidence of the presence of Abelisaurids in Europe . Arcovenator presents strong similarities with the Madagascan Majungasaurus and Indian abelisaurids , but not with the South American forms . Arcovenator , Majungasaurus and Indian forms are united in the new clade Majungasaurinae .

= = Classification = =

Paleontologists Jose Bonaparte and Fernando Novas coined the name Abelisauridae in 1985 when they described the eponymous Abelisaurus . The name is formed from the family name of Roberto Abel , who discovered Abelisaurus , as well as from the Greek word ?????? / sauros meaning ' lizard ' . The very common suffix -idae is usually applied to zoological family names and is derived from the Greek suffix -???? / -idai , which indicates a plural noun .

Abelisauridae is a family in rank @-@ based Linnaean taxonomy , within the infraorder Ceratosauria and the superfamily Abelisauroidea , which also contains the family Noasauridae . It has had several definitions in phylogenetic taxonomy . It was originally defined as a node @-@ based taxon including Abelisaurus , Carnotaurus , their common ancestor and all of its descendants .

Later it was redefined as a stem @-@ based taxon , including all animals more closely related to Abelisaurus (or the more complete Carnotaurus) than to Noasaurus . The node @-@ based definition would not include animals like Rugops or Ilokelesia , which are thought to be more basal than Abelisaurus and would be included by a stem @-@ based definition . Within Abelisauridae is the subgroup Carnotaurinae , and among carnotaurines , Aucasaurus and Carnotaurus are united in Carnotaurini .

= = = Shared characteristics = = =

Complete skeletons have been described only for the most advanced abelisaurids (such as Carnotaurus and Aucasaurus) , making it difficult to establish defining features of the skeleton for the family as a whole . However , most are known from at least some skull bones , so known shared features come mainly from the skull .

Many abelisaurid skull features are shared with carcharodontosaurids . These shared features , along with the fact that abelisaurids seem to have replaced carcharodontosaurids in South America , have led to suggestions that the two groups were related . However , no cladistic analysis has ever found such a relationship and , aside from the skull , abelisaurids and carcharodontosaurids are very different , more similar to ceratosaurs and allosauroids , respectively .

= = = Phylogeny = = =

Below is a cladogram generated by Tortosa et al . (2013) in the description of Arcovenator and creation of a new subfamily Majungasaurinae .

Ilokelesia was originally described as a sister group to Abelisauroidea . However , Sereno tentatively places it closer to Abelisaurus than to noasaurids , a result which agrees with several other recent analyses . If a stem @-@ based definition is used , Ilokelesia and Rugops are therefore basal abelisaurids . However , as they are more basal than Abelisaurus , they are outside of Abelisauridae if the node @-@ based definition is adopted . Ekrixinatosaurus was also published in 2004 , so it was not included in Sereno 's analysis . However , an independent analysis , performed by Jorge Calvo and colleagues , shows it to be an abelisaurid .

Some scientists include Xenotarsosaurus from Argentina and Compsosuchus from India as basal abelisaurids , while others consider them to be outside Abelisauroidea . The French Genusaurus and Tarascosaurus have also been called abelisaurids but both are fragmentary and may be more basal ceratosaurians .

With the description of Skorpiovenator in 2008 , Canale et al. published another phylogenetic analysis focusing on the South American abelisaurids . In their results , they found that all South American forms , including Ilokelesia (except Abelisaurus) , grouped together as a sub @-@ clade of carnotaurines , which they named Brachyrostra . In the same year Matthew T. Carrano and Scott D. Sampson published new large phylogenetic analysis of ceratosaurian . With the description of Eoabelisaurus , Diego Pol and Oliver W. M. Rauhut (2012) combined these analyses and added ten new characters . The following cladogram follows their analysis .