

MORPHOLOGIC AND ONTOGENETIC PATTERNS IN ELASMOSAUR NECK LENGTH, WITH COMMENTS ON THE TAXONOMIC UTILITY OF NECK LENGTH VARIABLES

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ABSTRACT

Elasmosaur cervical vertebrae are common fossils, but their taxonomic utility is limited due to a lack of understanding concerning their shape within and among taxa. In this paper, we analyze data from complete elasmosaur necks in an attempt to quantify and understand the variation in centrum dimensions. In accord with previous studies, variation in cervical centrum shape is found to stem from at least three sources: ontogeny, intracolumn variation, and intercolumn or taxonomic variation. Ontogenetic variability seems reminiscent of that seen in *Cryptoclidus*, with an overall positive allometry in the length of all centra that is accentuated in the mid-cervical region. In adult elasmosaurs, the longest centra occur in the middle of the neck, and centra in this region are longer than those at either end. This pattern yields a distinctively bowed shape curve when a shape metric such as VLI or PC2 score is graphed against vertebral position. Centrum length shows minor variation from centrum to centrum in all elasmosaurs, but a small group of extreme, 'elongate' animals have a much higher degree of variability. Animals in this group show significant changes in centrum dimensions late in ontogeny. The taxonomic utility of centrum measures is limited because there is no single pattern of centrum shape common to all taxa; variability is the rule, and therefore caution is necessary when using dimensions to diagnose taxa. There do seem to be two morphotypes of elasmosaurs, however. The first is a relatively conservative group with centrum dimensions similar to those of *Brancasaurus*, and that achieves a long neck by adding vertebrae. A second, elongate group has centra that are very long, and there is great variability from one centrum to another in the same column. Surprisingly, the number of cervical centra is not a highly variable trait in most elasmosaurs. The elongate taxa appear to be restricted to the Western Interior Seaway in the Late Cretaceous, although there is some indication that *Tuarangisaurus* might be elongate as well. In general, elasmosaur vertebrae have some taxonomic utility, but only at the extremes of their shape range, if the specimens are adults, and only if their position in the column is known with some certainty.