NARIAL ANATOMY OF ANKYLOSAURIAN DINOSAURS: OSTEOLOGY AND

SOFT-TISSUE RECONSTRUCTION

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The narial regions of ankylosaurian dinosaurs are unusual and derived. In most ankylosaurs, the region of the bony nostril, corresponding to the region of the nasal vestibule, is enlarged. Vestibular enlargement is not always apparent externally because of overgrowth of the narial region by bones derived from the skin (i.e., osteoderms). CT scans of juvenile *Pinacosaurus* confirm that the bony nostril (as defined by the margins of the premaxilla and nasal) is very large. In fact, in most ankylosaurs, the apparent size and orientation of the external nasal opening is dictated largely by the extent of osteoderm formation within the narial skin. For example, the seemingly divergent ventral displacement of the nasal openings in *Ankylosaurus* probably simply reflects more extensive (perhaps allometric) ossification within the narial skin. On the one hand, interpretation is complicated by the presence of osteoderms in the narial region. On the other hand, these osteoderms aid interpretation in that their highly sculptured surfaces contrast markedly with the smooth bone surface of the nasal vestibule, allowing relatively clear assignment of anatomical domains. For example, the external surfaces of the nasal osteoderms in *Pinacosaurus* bear ornamentation patterns characteristic of skin-covered bone, whereas their internal surfaces are smooth, reflecting their having been lined with moist nasal epithelium. Many ankylosaurs have apertures in the narial region in addition to the airway. In virtually all ankylosaurs, a caudolateral aperture conducts large blood vessels into the narial region; fossae directly rostral to this vascular opening are consistent with the presence of a mass of erectile tissue. This mass helps corroborate a position of the fleshy nostril at the rostroventral margin of the narial region. Some ankylosaurids have apertures that open into a large space within the premaxilla. The variability of these foramina (taken to an extreme in *Pinacosaurus*) supports their interpretation as pneumatic foramina.