

## Fused and vaulted nasals of tyrannosaurid dinosaurs: Implications for cranial strength and feeding mechanics

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Tyrannosaurid theropods display several unusual adaptations of the skulls and teeth. Their nasals are fused and vaulted, suggesting that these elements braced the cranium against high feeding forces. Exceptionally high strengths of maxillary teeth in *Tyrannosaurus rex* indicate that it could exert relatively greater feeding forces than other tyrannosaurids. Areas and second moments of area of the nasals, calculated from CT cross-sections, show higher nasal strengths for large tyrannosaurids than for *Allosaurus fragilis*. Cross-sectional geometry of theropod crania reveals high second moments of area in tyrannosaurids, with resulting high strengths in bending and torsion, when compared with the crania of similarly sized theropods. In tyrannosaurids trends of strength increase are positively allometric and have similar allometric exponents, indicating correlated progression towards unusually high strengths of the feeding apparatus. Fused, arched nasals and broad crania of tyrannosaurids are consistent with deep bites that impacted bone and powerful lateral movements of the head for dismembering prey.

**Key words:** : Theropoda, Carnosauria, Tyrannosauridae, biomechanics, feeding mechanics, computer modeling, computed tomography.

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