

C.F. Ross and Metzger, K.A.

Stony Brook University.
Presented at SICB 2004.

kmetzger@ic.sunysb.edu

Strain gradients and optimality criteria in vertebrate skulls.

Vertebrate crania house many different functional systems, suggesting that they are unlikely to be optimally designed for resisting feeding forces, but will instead compromise optimality in the feeding system when requirements of other functional systems demand it. Defining optimality in the bony skeleton as maximum strength with minimum material, this hypothesis is evaluated using in vivo bone data from our own work, augmented with data from the literature. Variation in bone strain magnitudes across the crania of pigs, four species of primates, and *Alligator* does not match predictions from the global loading regimes to which they are subjected (i.e., torsion and bending). A common pattern of strain gradients across the taxa is identified: low strains in orbital and neurocranial regions, and high strains in the zygomatic region and mandible. Strain magnitudes in the *Alligator* skull are much higher than those in primates, approaching or exceeding the highest strains recorded in vertebrates. Lack of optimality for feeding in the primate cranium has also been attributed to selection for other functions. Non-mammalian tetrapod crania also house many different functional systems but there are taxonomic differences associated with differences in skull design. Elevated strain magnitudes in *Alligator* suggest that their skulls may need to be more optimally designed for resisting feeding forces than those of mammals. Funded by NSF Physical Anthropology.