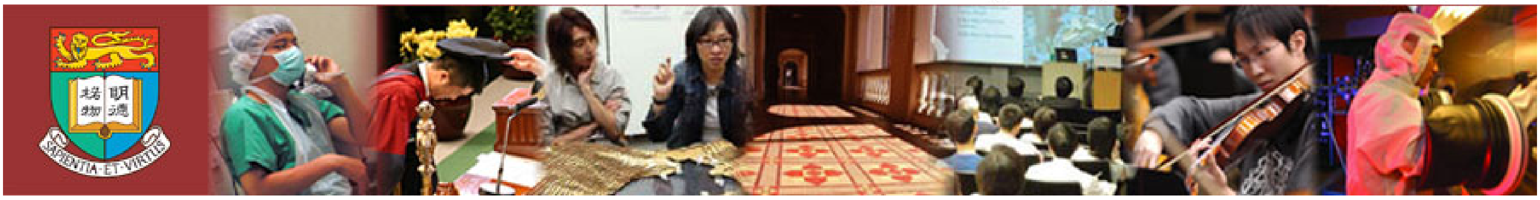

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THE EVOLUTION OF TAIL JOINT STIFFNESS IN OVIRAPTOROSAUR DINOSAURS AND ITS CONSEQUENCES FOR TAIL FUNCTION

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Oviraptorosaurs preserve distal tail fronds that are sometimes articulated with a fused pygostyle-like structure. This similarity with birds has led to speculation that they used their tails for display purposes, as in peacocks. The prezygapophyseal morphology and craniocaudally short centra of oviraptorosaur tails indicate a high degree of flexibility per unit of absolute tail length. Their prezygapophyses permitted a large range of motion per joint, which increased tail mobility because the craniocaudally shorter centra allowed the tail to accommodate more joints per unit length. The large muscle volumes reconstructed for oviraptorosaur tails presumably helped to actively stiffen or move them. We predict high passive joint stiffness in their tails because their great depth and breadth created longer moment arms for tissue to leverage its resistance against dorsally/ventrally or laterally directed joint rotation respectively. Shorter tails that evolved via craniocaudally shorter centra also lead to the same prediction because centrum length affects the length of muscle spanning the vertebrae, which inversely correlates with joint stiffness. But how did joint stiffness evolve and affect tail function? From four taxa, we reconstructed the size-normalized changes in vertebral morphology between the unnamed node between Oviraptorosauria and Paraves (node A) and the oviraptorid node, and used this to reconstruct changes in passive joint stiffness. Increased dorsoventral height of the hypothetical vertebrae between node A and the oviraptorid node supports an increase in dorsoventral joint stiffness, although the latter decreased according to trends in centrum height and chevron depth. Between these nodes, lateral joint stiffness increased, as is evident from increased transverse length and vertebral width and decreased centrum length. Both joint stiffness trends coincide with tail shortening and reduced caudal count between node A and the oviraptorosaurian node, and increased caudal count between the latter and the oviraptorid node. These results show that oviraptorosaur tails were mechanically appropriate for holding themselves up, particularly as they were heavier compared to paravians despite being shorter. The lower caudal count in oviraptorosaurs compared to node A indicates a greater range of motion per joint in the former, if tail mobility was constant. Thus, increased dorsoventral and lateral joint stiffness may have helped them produce the range of muscular force vectors needed for complex tail display or behavior.