

## Finite Element Analysis (FEA) Reveals Increased Force Used by the Forelimbs in the Sabertooth Cat, *Smilodon fatalis*

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The sabertooth cat, *Smilodon fatalis*, was a carnivorous predator that lived during the Ice Age, or Pleistocene Epoch 2.5 million to 11,000 years ago. Unlike modern cats that kill their prey with a suffocating bite to the windpipe, sabertooth cat teeth were too fragile for this method of prey-killing. Sabertooth cats were known to have muscular forelimbs to hold prey down before delivering a fatal bite to the neck viscera with their large saber canines. Morphological specimens were measured and analyzed using finite element analysis technology, an engineering technique that utilizes the material properties of solids to stimulate stress and strain in the material of interest. Bone tissue of the the humerus was used to compare the stress and strain potential of the sabertooth cat, *S. fatalis*, to living large cats.

We leveraged heterogeneous finite element (FE) models generated with species-specific material properties to assess the strength of *S. fatalis*' forelimbs in prey-holding posture. Results indicate *S. fatalis* had the strongest overall forearm strength compared to pantherines, exceeding that of lion (*P. leo*), leopard (*P. pardus*), jaguar (*P. onca*), and was most similar to tiger (*P. tigris*). These findings are consistent with the inference that sabertooth evolution involved widespread modification and coordination of musculoskeletal performance in increasingly specialized forms.