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Abstract:
The degree to which evolutionary change in the cranial base was an integrative influence on other aspects of craniofacial evolution in hominids is a subject of much debate. Using a mouse model, we test the hypothesis that a mutation which produced a shortening of the cranial base creates some of the same changes seen in hominid evolution, such as increased cranial flexion, retraction of the face and increased neurocranial height. The Brachymorph (bm) mutant mice posses an autosomal recessive mutation that affects the sulfation of cartilage matrix glycosaminoglycans, initiating hyper-ossification and stunting of endochondral bone. In the cranium, this produces a reduction of the size of the basicranium. We obtained 3D reconstructions of brachymorph mutants (N=21) and wildtype littermates (N=19) using computed microtomography and performed morphometric analysis of 3D landmarks. Principal components analysis of Procrustes coordinates for the combined sample revealed a clear separation in shape for the two groups as well as shape variation consistent with the hypothesis. Euclidean distance matrix analysis revealed that the Brachymorph mutants had a significantly shorter (>10%) cranial base (at p=.05), as well as a significant increase in neurocranial height (>10%). We also found a significant increase in both cranial base flexion ($t=3.899$, $df=25$, $p<<.05$) and facial retraction ($t=-3.157$, $df=24$, $p<<.05$). These results demonstrate that the Brachymorph mutation produces cranial characteristics that mirror some of the changes seen in hominid evolution. This study provides evidence, in the mouse model, which suggests an integrative role for the basicranium in human evolution.