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Tissue Origins and Interactions in the Mammalian Skull Vault

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Abstract

During mammalian evolution, expansion of the cerebral hemispheres was accompanied by expansion of the frontal and parietal bones of the skull vault and deployment of the coronal (fronto-parietal) and sagittal (parietal–parietal) sutures as major growth centres. Using a transgenic mouse with a permanent neural crest cell lineage marker, *Wnt1-Cre/R26R*, we show that both sutures are formed at a neural crest–mesoderm interface: the frontal bones are neural crest-derived and the parietal bones mesodermal, with a tongue of neural crest between the two parietal bones. By detailed analysis of neural crest migration pathways using X-gal staining, and mesodermal tracing by DiI labelling, we show that the neural crest–mesodermal tissue juxtaposition that later forms the coronal suture is established at E9.5 as the caudal boundary of the frontonasal mesenchyme. As the cerebral hemispheres expand, they extend caudally, passing beneath the neural crest–mesodermal interface within the dermis, carrying with them a layer of neural crest cells that forms their meningeal covering. Exposure of embryos to retinoic acid at E10.0 reduces this meningeal neural crest and inhibits parietal ossification, suggesting that intramembranous ossification of this mesodermal bone requires interaction with neural crest-derived meninges, whereas ossification of the neural crest-derived frontal bone is autonomous. These observations provide new perspectives on skull evolution and on human genetic abnormalities of skull growth and ossification.

Keywords

mouse development; neural crest; mesoderm; skull sutures; Wnt1; retinoic acid

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