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Bmp Activity Gradient Regulates Convergent Extension during Zebrafish Gastrulation

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Abstract

During vertebrate gastrulation, a ventral to dorsal gradient of bone morphogenetic protein (Bmp) activity establishes cell fates. Concomitantly, convergent extension movements narrow germ layers mediolaterally while lengthening them anteroposteriorly. Here, by measuring movements of cell populations *in vivo*, we reveal the presence of three domains of convergent extension movements in zebrafish gastrula. Ventrally, convergence and extension movements are absent. Lateral cell populations converge and extend at increasing speed until they reach the dorsal domain where convergence speed slows but extension remains strong. Using dorsalized and ventralized mutants, we demonstrate that these domains are specified by the Bmp activity gradient. *In vivo* cell morphology and behavior analyses indicated that low levels of Bmp activity might promote extension with little convergence by allowing mediolateral cell elongation and dorsally biased intercalation. Further, single cell movement analyses revealed that the high ventral levels of Bmp activity promote epibolic migration of cells into the tailbud, increasing tail formation at the expense of head and trunk. We show that high Bmp activity limits convergence and extension by negatively regulating expression of the *wnt11* (*silberblick*) and *wnt5a* (*pipetail*) genes, which are required for convergent extension but not cell fate specification. Therefore, during vertebrate gastrulation, a single gradient of Bmp activity, which specifies cell fates, also regulates the morphogenetic process of convergent extension.

Keywords



convergence; extension; morphology; dorsoventral patterning; morphogenesis





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