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Evolutionary recruitment of flexible *Esrp*-dependent splicing programs into diverse embryonic morphogenetic processes

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Epithelial-mesenchymal interactions are crucial for the development of numerous animal structures. Thus, unraveling how molecular tools are recruited in different lineages to control interplays between these tissues is key to understanding morphogenetic evolution. Here, we study *Esrp* genes, which regulate extensive splicing programs and are essential for mammalian organogenesis. We find that *Esrp* homologs have been independently recruited for the development of multiple structures across deuterostomes. Although *Esrp* is involved in a wide variety of ontogenetic processes, our results suggest ancient roles in non-neural ectoderm and regulating specific mesenchymal-to-epithelial transitions in deuterostome ancestors. However, consistent with the extensive rewiring of *Esrp*-dependent splicing programs between phyla, most developmental defects observed in vertebrate mutants are related to other types of morphogenetic processes. This is likely connected to the origin of an event in *Fgfr*, which was recruited as an *Esrp* target in stem chordates and subsequently co-opted into the development of many novel traits in vertebrates.

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