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How the embryonic brain tube twists ZI CHEN, Washington University, QIAOHANG GUO, Fuzhou University, NICKOLAS FORSCH, LARRY TABER, Washington University — During early development, the tubular brain of the chick embryo undergoes a combination of progressive ventral bending and rightward torsion. This deformation is one of the major organ-level symmetry-breaking events in development. Available evidence suggests that bending is caused by differential growth, but the mechanism for torsion remains poorly understood. Since the heart almost always loops in the same direction that the brain twists, researchers have speculated that heart looping affects the direction of brain torsion. However, direct evidence is virtually nonexistent, nor is the mechanical origin of such torsion understood. In our study, experimental perturbations show that the bending and torsional deformations in the brain are coupled and that the vitelline membrane applies an external load necessary for torsion to occur. In addition, the asymmetry of the looping heart gives rise to the chirality of the twisted brain. A computational model is used to interpret these findings. Our work clarifies the mechanical origins of brain torsion and the associated left-right asymmetry, reminiscent of D'Arcy Thompson's view of biological form as "diagram of forces".

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