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Non-motile (9+0) Primary Cilia in Cell Culture Exhibit Constrained Motion

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The primary cilium is a common structural feature found on many mammalian cells *in vivo*, shown to be important for mechanosensation, chemosensation, and signaling. This organelle protrudes 5 to 55 μm from the surface of the cell and is composed of a circular bundle of 9 microtubule doublets (9+0) enveloped in plasma membrane. This cilium does not have two internal microtubules in contrast to motile (9+2) cilia and flagella, which contain two additional central microtubules. Hence, primary cilia were long considered non-motile. Recently, movement of primary cilia was observed in the embryonic node (nodal cilia). This rather rapid movement (~50Hz) is thought to be essential for left-right symmetry breaking in early embryonic development. Using live-imaging of fluorescent markers we observe constrained circular motion of primary cilia in cultured cells. We characterized this motion by tracking the distal end of the cilium. The timescale of this movement is significantly slower than observed in nodal and motile (9+2) cilia. Additionally, this motion is not nearly as processive as that of its nodal and (9+2) counterparts, though it may exhibit a preference in angular step-size. Identifying the function and mechanism of this motility may prove important for understanding the complex physiology of primary cilia.
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