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Mechanical Properties of a Primary Cilium Measured by Resonant Oscillation ANDREW RESNICK, Cleveland State Unviersity — Primary cilia are ubiquitous mammalian cellular substructures implicated in an ever-increasing number of regulatory pathways. The well-established 'ciliary hypothesis' states that physical bending of the cilium (for example, due to fluid flow) initiates signaling cascades, yet the mechanical properties of the cilium remain incompletely measured, resulting in confusion regarding the biological significance of flow-induced ciliary mechanotransduction. In this work we measure the mechanical properties of a primary cilium by using an optical trap to induce resonant oscillation of the structure. Our data indicate 1), the primary cilium is not a simple cantilevered beam, 2), the base of the cilium may be modeled as a nonlinear rotatory spring, the linear spring constant 'k' of the cilium base calculated to be (4.6 +/- 0.62)*10^{-12} N/rad and nonlinear spring constant 'α' to be (-1 +/- 0.34) *10^{-10} N/rad^2 , and 3) the ciliary base may be an essential regulator of mechanotransduction signalling. Our method is also particularly suited to measure mechanical properties of nodal cilia, stereocilia, and motile cilia, anatomically similar structures with very different physiological functions.

Andrew Resnick
Cleveland State Unviersity

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