Tata Institute of Fundamental Research
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Seminar

Decoding the role of mechanics in organ morphogenesis

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Organ morphology is critical for its function. While biochemical cues are well-studied, mechanical forces are increasingly recognised as crucial regulators of cell and tissue behaviours during organ development. Using the *Caenorhabditis elegans* gonad as a model, we investigate how mechanical cues contribute to organ morphogenesis *in vivo*.

Our work reveals that gonad morphogenesis in *C. elegans* is a result of directed cell invasion and asymmetric adhesion. Germ cell proliferation within an enclosed basement membrane generates pressure that is released at the distal tip of the gonad by matrix remodelling. A somatic cell called the distal tip cell (DTC) is responsible for matrix degradation and secretion, which enable gonad elongation. Furthermore, the DTC utilises asymmetric integrin-mediated matrix adhesions to steer itself and perform a U-turn.

Next, we investigated the role of nuclear localisation during gonadogenesis. We show that the DTC relies on precise nuclear positioning to maintain its integrity and function while navigating through a complex 3D tissue microenvironment. This is achieved through two complementary mechanical mechanisms: microtubule motor-driven nuclear transport and actomyosin-mediated cortical tension. Disruption of nuclear positioning along with actomyosin contractility leads to DTC fragmentation and gonad bifurcation.

Collectively, our findings uncover a multi-scale mechanical program – spanning proliferative pressure, matrix remodelling, adhesion dynamics, and intracellular force generation – that orchestrates organ morphogenesis *in vivo*.

Tuesday, Jul 15th 2025

16:00 Hrs (Tea / Coffee 15:45 Hrs)

Auditorium, TIFRH