BDR SEMINAR (Kobe & online hybrid)

Co-hosted by
Multimodal ECM Seminar

Transformative Research Area (A)
MULTIMODAL ECM

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Thursday, December 18, 2025
11:00-12:00
1F Auditorium, DB Building C, Kobe / Broadcast online via Zoom
Zoom meeting URL will be announced on the event day by e-mail.
※This seminar is open only to BDR members.

Mechanisms of Biological Processes Driven by Cell-Matrix Interactions

Summary

During various biological processes, cells interact mechanically with a surrounding extracellular matrix (ECM). Forces generated in cells are transmitted to ECM, resulting in structural remodeling of ECM. To better understand cell-ECM interactions, a myriad of in vitro experiments and simulations have been performed during recent decades, with the assumption that ECM behaves as an elastic material. However, physiological ECMs are viscoelastic, exhibiting stress relaxation or creep over time. It remains poorly understood how the load- and time-dependent properties of ECM affect mechanical interactions between cells and ECM. We have employed computational models to investigate the mechanisms of biological processes driven by interactions between cells and viscoelastic ECM. For example, we demonstrated how cells, such as fibroblast and cancer cells, can remodel surrounding ECMs by exerting contractile or shear forces and migrate along aligned ECM fibers resulting from the remodeling process. In addition, we showed how dividing cells exert both expansile and contractile forces to make sufficient space for successful cell division and how their surrounding ECM resists elongating cells for cell division. We verified these simulation results using in vitro experiments performed with cells encapsulated by hydrogels with tunable rheological properties or collagen matrices. Our studies provide key insights into understanding how physiologically relevant mechanical interactions between cells and ECM mediate diverse biological processes.

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