Bioengineered assays for cell migration studies

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Many physiological and pathological processes involve directed cell motion. Directed cell migration is usually thought to depend on the presence of long-range gradients of either chemo-attractants or physical properties, such as stiffness or adhesion *[1]*. However, *in vivo*, chemical or mechanical gradients have not systematically been observed. In this talk, I will present recent *in vitro* experiments which show that other types of spatial guiding cues can bias cell motility *[2]*. Introducing local geometrical or mechanical anisotropy in the cell environment, such as adhesive *[3, 4]* or topographical micro-ratchets *[5, 6],* show that local and periodic external cues can direct cell motion. I will show the importance of protrusion fluctuations in setting the direction of cell motion, and how their spatiotemporal distribution and dynamics determine the fluctuations and direction of cell motion.

Under certain circumstances, mechanical constraints and chemical gradients can both contribute to the establishment of cell direction. We found that the nucleus dictates the direction of cell movement through mechanical guidance by its environment, and demonstrate that this direction can be tuned by combining the topographical ratchet with a biochemical gradient of adhesion. Interestingly, we found competition and cooperation between the two external cues. Together with modeling, these experiments suggest that cell motility is a stochastic phenomenon which can be biased by various types of local cues, leading to directional migration.

Finally, I will present our most recent results on cell migration using *in-vitro* native-like environments. Our aim is to study how cell migration is determined by both mechanical and biochemical factors during physiological and pathological processes.

References

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