M2 INTERNSHIP

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Student profile: (bio-)physicist/engineer, no prerequisite in biology but a solid motivation for this experimental internship

Subject of the internship: White blood cell mechanics

We are specialized in the study of mechanical aspects of immune response at the single-cell level[1-6]. White blood cells (or leukocytes) exert forces during an immune response, for example during theirinteraction with another cell to attack it or exchange information with it. We have shown that some types of white blood cells adapt the forces they generate to the mechanical properties of their target[2,3], but also that they change their own mechanical properties during this process. These active aspects are still poorly understood, and understanding them can help better understanding both fundamental aspects of immune response and more medically applied aspects such as cancer and respiratory diseases.

To study these mechanical processes at the single cell level, we have developed a micropipette force probe that allows to measure the forces generated by white blood cells during their activation[3,4]. We have expander this method into a single-cell rheometer (figure 1) that allows tracking viscoelastic changes in white blood cells during activation[5,6]. In this experimental internship, the goal will be to characterize how mechanical properties of a white blood cell change over time during its activation or in the presence of different soluble stimuli. Several directions are possible depending on the type of white blood cell studied, but the internship will involve cutting edge, and demanding, micromanipulation experiments that can lead to unique observations of white blood cell mechanical behavior. We invite motivated candidates to contact us to discuss about this internship.

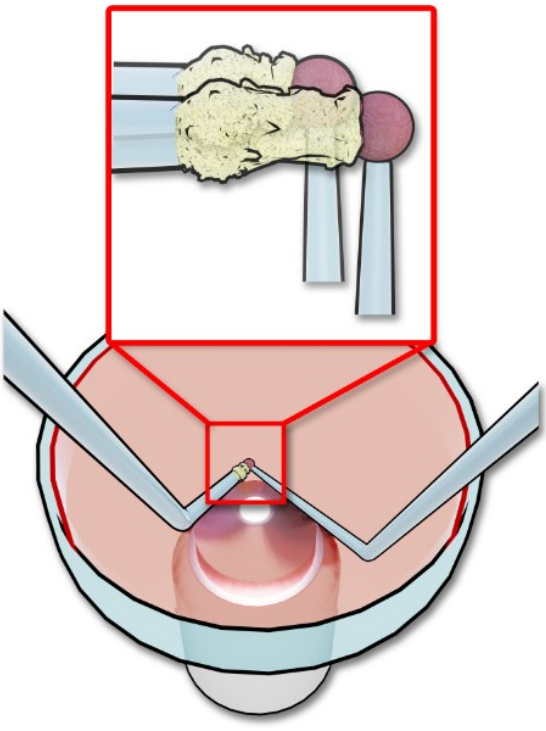

Figure 1| Micropipette Force Probe setup. Two micropipettes are placed in a Petri dish. A flexible pipette (right, bending stiffness k≈0.2 nN/µm) holds an activating microbead firmly. A rigid micropipette (left) gently holds a leukocyte (inset). The base of the flexible micropipette is translated to impose a desired force on the cell. Recording the resulting deformation of the cell allows measuring its viscoelastic properties. A movie (time x30) showing the activation of a T cell can be seen here.

References

[1] https://cellmechanics.jimdo.com
[2] Husson et al., PLoS One 2011
[3] Sawicka et al., Mol. Biol. Cell 2017
[4] Basu et al. Cell 2016
[5] Guillou et al., Mol. Biol. Cell 2016
[6] Guillou et al., Sc. Reports 2016