Optical Tweezers for IVF: an *in vitro* study of reproductive cells and their environment

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Optical imaging has significantly changed how we view the biological world. However, optics are not simply a tool for observation but can also manipulate diagnostic probes for the accurate characterization of complex biomechanical processes. A prime example is optical tweezers which use a tightly focused light beam to trap microscopic particles or cells in 3D. These can act as localized probes for precision measurement of distances or forces [1]. They act as a useful tool for microrheology. A cell's mechanical response can aid an understanding of its health and function and tweezers are powerful tools for the measurement of local viscosity and elasticity of cells and motors at the microscale [2] [3]. In the field of reproduction, there is a burgeoning need to understand how native cell properties of the gametes/embryo, or the properties of its environment are associated with its post-IVF outcomes.

Here we explore the application of the optical tweezers for the microrheology of gametes, embryos, or their surrounding environment (culture media). The goal is to perform cellular manipulation and monitor viscosity of media with both the equipartition method and power spectrum analysis (Fig. 1.). We aim to investigate how the microrheology is correlated to embryo development and implantation success. This is to be contrasted with previous bulk measurements of viscosity in the field [4]. This work has great potential in exploring the use of the optical tweezers for characterizing native cell properties of reproductive cells, a prospect which may assist in the diagnosis of embryos that have a higher likelihood of resulting in a pregnancy.

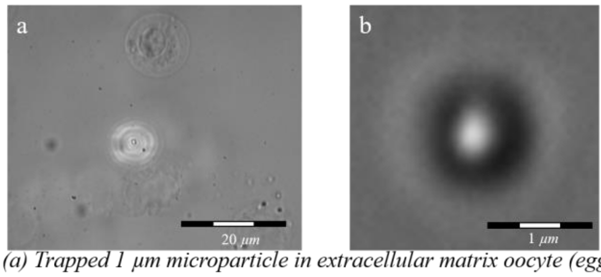

Figure 1: (a) Trapped 1 μm microparticle in extracellular matrix oocyte (egg). Cumulus cells found above and below oocyte (b) Trapped 1 μm bead in IVF culture media

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