# Determination of cell state in ulcerative colitis patients by real-time deformability cytometry

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Real-time deformability cytometry (RT-DC) has lately emerged as an alternative for cell stiffness measurements [1], in addition to standard methods such as atomic force microscopy (AFM) indentation and optical tweezers/laser traps [2]. In comparison to these techniques, RT-DC provides information on cell stiffness in a matter of minutes. In this regard, RT-DC is a good candidate for fast discrimination of cell changes in patients suffering of inflammatory bowel diseases (IBD) like ulcerative colitis.
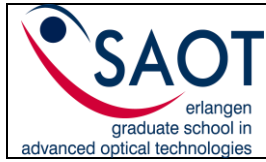
In this work, we investigated specific cell stiffness parameters in comparison to the progression of disease. Blood samples were collected from patients with different stages of ulcerative colitis and then investigated with real-time deformability cytometry. A small volume of blood was diluted in viscosity-adjusted measurement buffer, added to a 1 ml syringe and connected via tubing to the microfluidic chip. The cells were then measured at a flow rate of 0.03 $\mu$l/s. Specific parameters such as cell deformability/circularity and surface area were used to differentiate between blood populations such as lymphocytes, monocytes, thrombocytes etc [3]. The data obtained on these populations were correlated to specific clinical parameters for ulcerative colitis prognosis such as Mayo score and C-specific protein (CrP).

When we investigated the cell surface area of cells in comparison to Mayo score, we observed three populations that were positively correlated to disease progression: eosinophils (r = 0.38), monocytes (r = 0.35) and neutrophils (r = 0.6). This data show that morphological changes occur in the immune system in patients with ulcerative colitis. Since neutrophils are the dominant population in blood samples, we further investigated changes in these cells [4]. We observed that cell surface area of neutrophils was positively correlated to CrP values as well (r = 0.42). Furthermore, the analysis of neutrophil circularity and deformability from RT-DC data with Mayo score have indicated negative correlation (r = -0.33) with circularity and positive correlation with deformability (r = 0.33). Such changes in cell size and morphology of neutrophils are an indication of an active immune system during the progression of the disease.

These preliminary results show the potential of RT-DC not only in determining cell changes in size, circularity and deformability in patients with ulcerative colitis, but also in correlating the results with disease activity.

## References
[1]     A. Mietke *et al.*, *Biophys. Journal* **109**, 2023-2036 (2015)
[2]     C. T. Lim *et al.*, *Journal Biomech.* **39**, 195-216 (2006)
[3]     N. Toepfner *et al.*, *eLife* **7**, (2018)
[4]     J. W. Leiding,  *Front. Immunol.* **8**, (2017)

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