SUPPORTING MATERIAL

Single-cell rheology of human primary immune cells reveals distinct mechanical properties that are modified by inflammatory conditions

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Figure S1

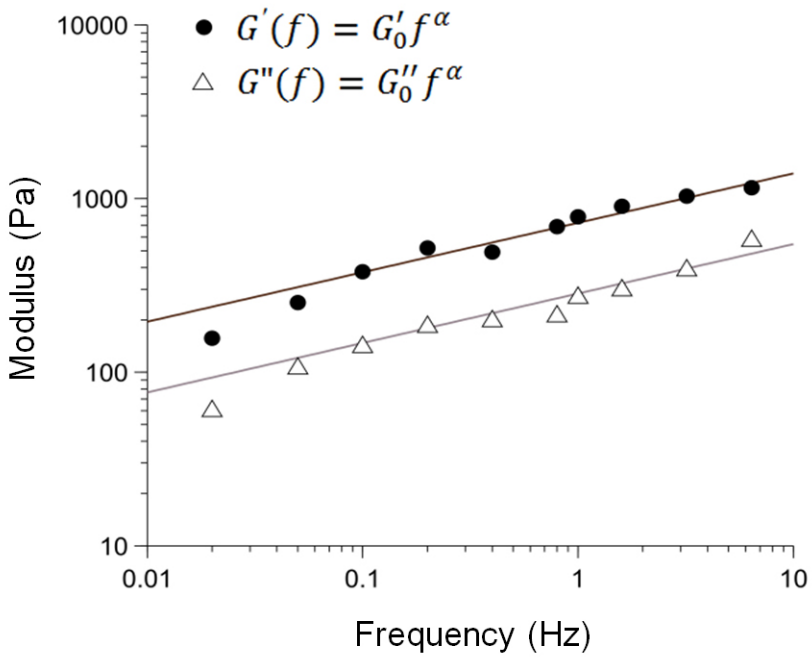

Figure S1. Example of storage modulus G_0' and loss modulus G_0'' from a single-cell dynamic mechanical experiment. Both moduli behave as a power law of frequency. For each cell the pre-factors of the fits $G'(f) = G_0' f^\alpha; G''(f) = G_0'' f^\alpha$ were extracted and used to compile statistics in each cell type and inflammatory condition. Measurements were performed on at least 15 individual cells from at least 3 different donors.

Figure S2

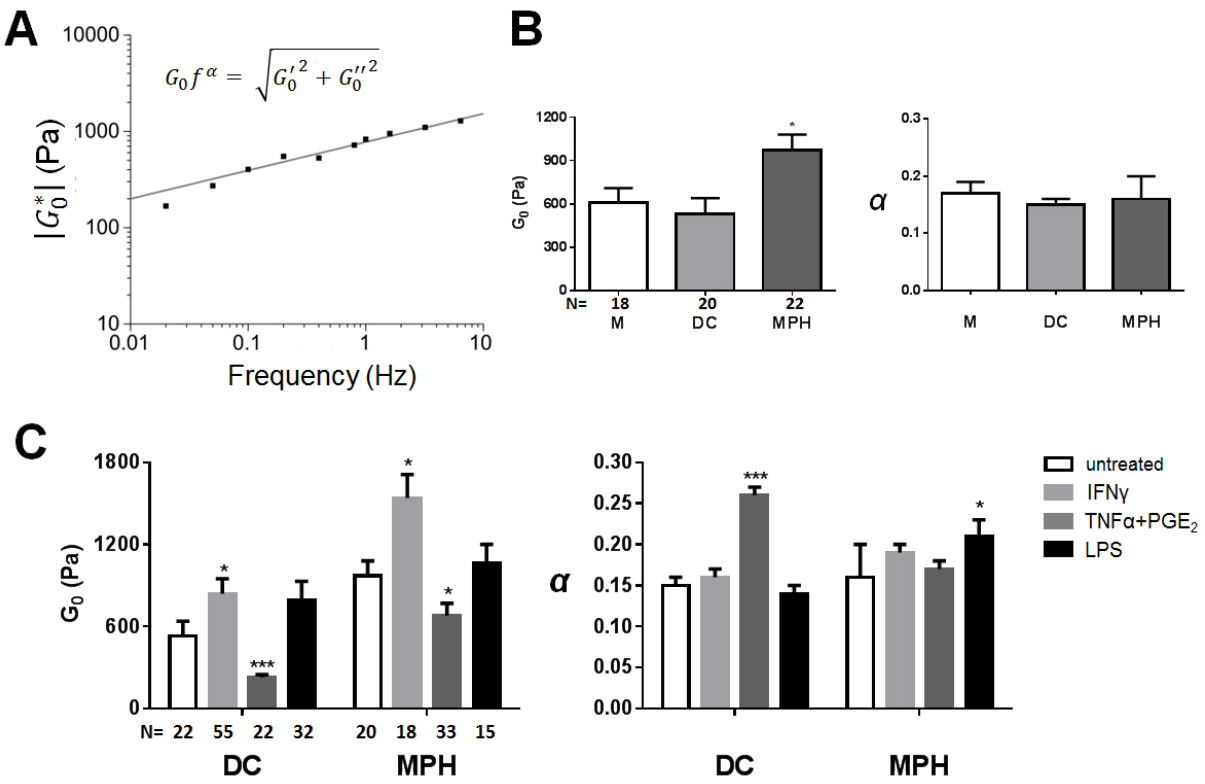

Figure S2. Complex viscoelastic measurement of single cells using the microplates assay. A) For each cell, the norm of the complex viscoelastic modulus $\left|G_0^*\right| = \sqrt{G_0'^2 + G_0''^2}$ was plotted according to frequency. Data were fitted by a power law to extract the viscoelastic modulus G_0 and exponent α: $\left|G_0^*\right| = G_0 f^a$, whose means were used as a comparison between (B) cell types and (C) inflammatory conditions . (* p<0.05, **p<0.01, ***p<0.001, Mann-Whitney-U test compared to untreated. N: number of cells tested, from at least 3 different donors).

Figure S3

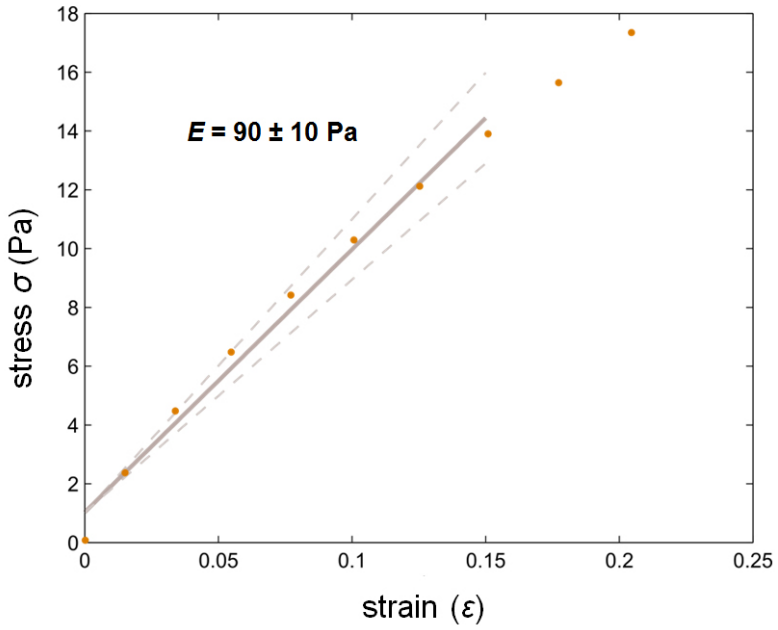

Figure S3. Estimation of Jurkat cell Young's modulus from single-cell viscoelastic measurements. Stress σ and strain ε are obtained from the equations presented in the methods section. After plotting σ as a function of ε (red dots), the Young's modulus is obtained by fitting the stress-strain curve (grey line) for strains below 15% (corresponding to experimental conditions). Dashed lines represent the standard error on the fit. The Young's modulus obtained for Jurkat cells is E = 90 ±10 Pa.

Figure S4

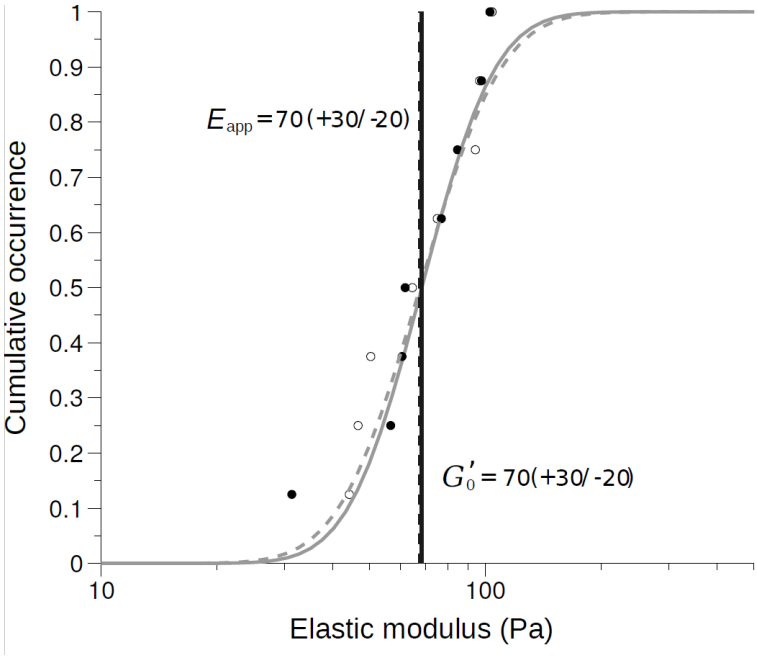

Figure S4. Equivalence between G_0' and E_{app} for Jurkat cells. For n = 8 cells, both step-wise compression (E_{app} in dark circles) and dynamic mechanical analysis (G_0' in white circles) were performed. The distributions and mean represented respectively by full lines for step-wise compression and dashed lines for dynamic mechanical analysis are equal for both types of measurement performed.

Figure S5

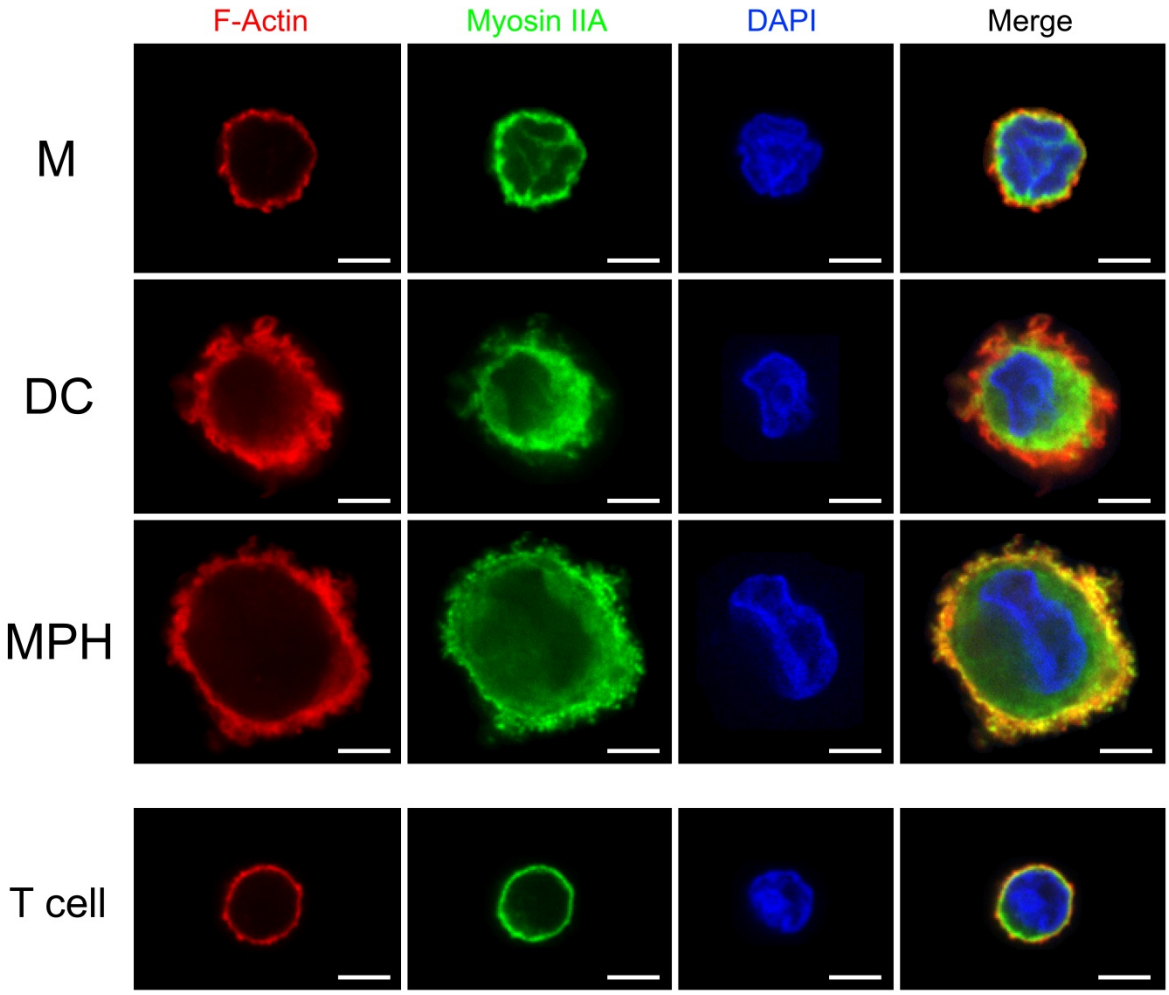

Figure S5. Antigen presenting cells (M, DC, MPH) were labeled with phalloidin, an anti-Myosin IIA antibody and DAPI. A representative confocal midplane is shown for each cell type. A labeled T cell is shown for comparison. Scale bar: 5 µm.

Figure S6

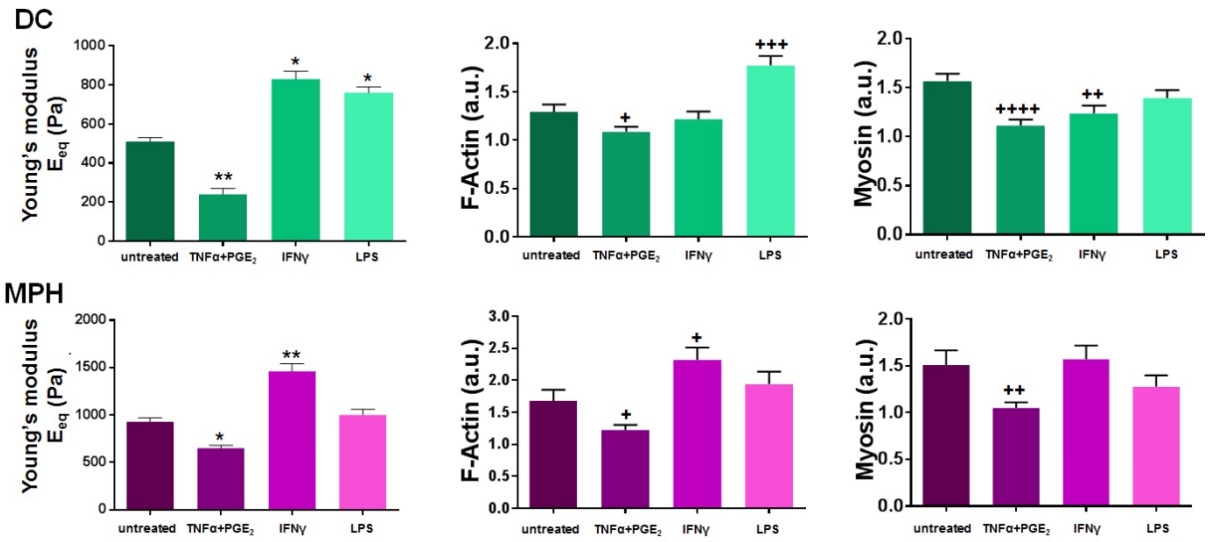

Figure S6. Values of equivalent Young's modulus E_{eq}, total F-Actin content and total myosin IIA heavy chain are shown for comparison of the effect of inflammatory conditions (TNFα+PGE_2, IFNγ or LPS) on A) DC, and B) MPH. (*p<0.05, **p<0.01, Mann-Whitney-U test compared to untreated, $^{+}$p<0.05, $^{++}$p<0.01, $^{+++}$p<0.001, $^{++++}$p<0.0001, unpaired t test with Welch's correction compared to untreated).

Figure S7

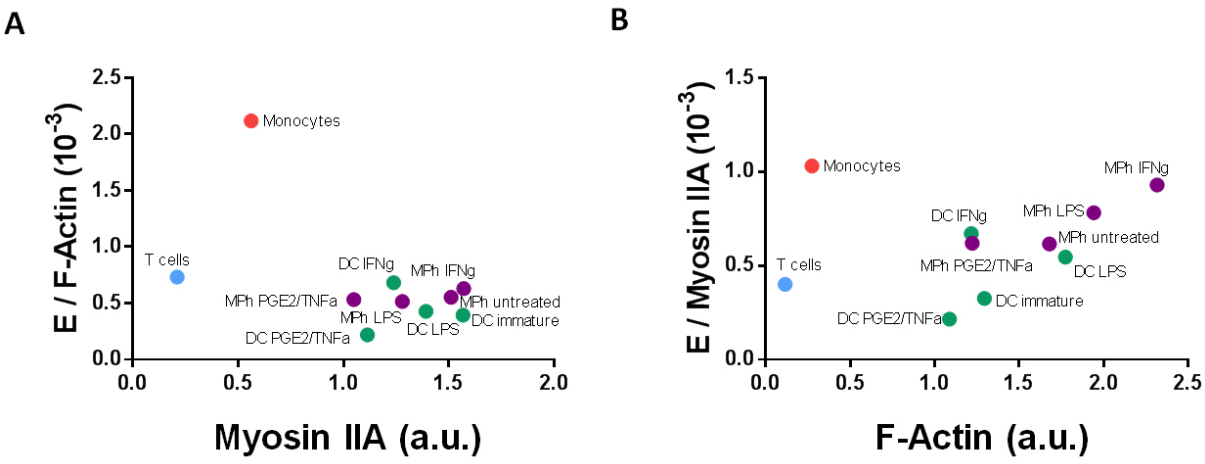

Figure S7. Plots of ratios: A) [E_{eq} / F-Actin] vs myosin IIA total content, and B) [E_{eq} / myosin IIA] vs F-Actin total content for Monocytes (●); T cells (●); DC (●) and MPH (●) for various inflammatory conditions.