Supplementary Material (ESI) for Lab on a Chip

Pinched flow coupled shear modulated inertial microfluidics for high throughput rare blood cell separation

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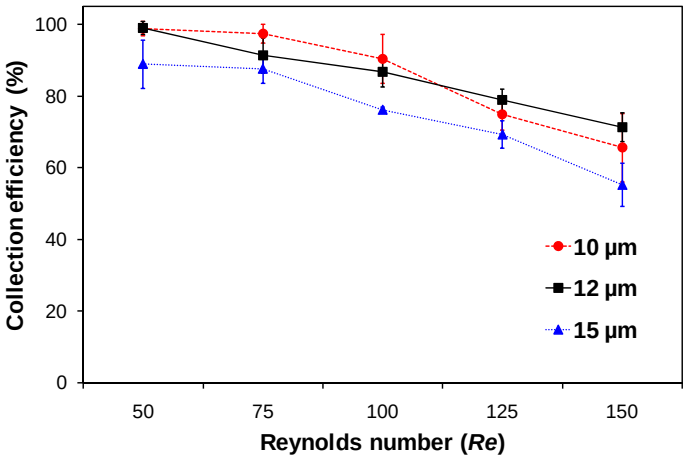
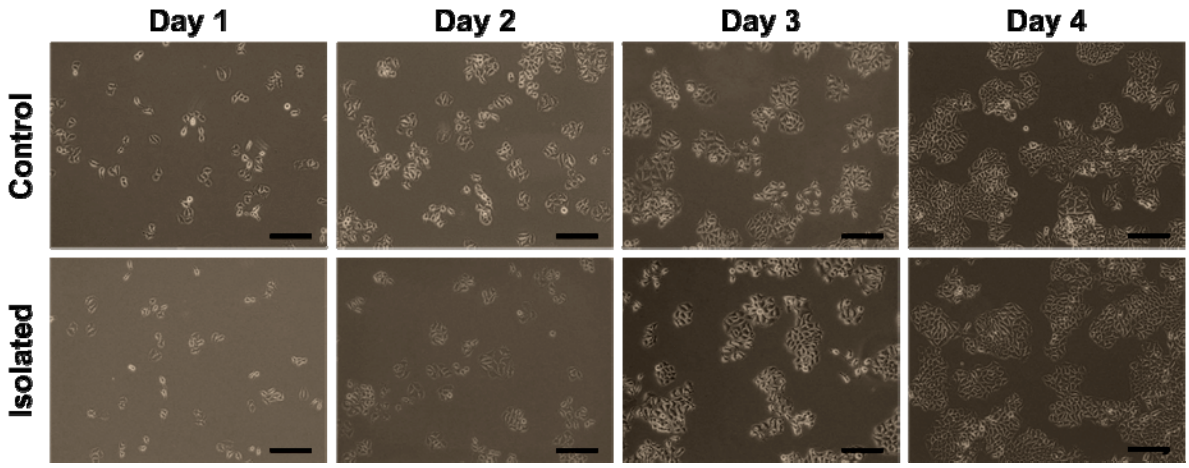
SUPPORTING INFORMATION

Figure S1.



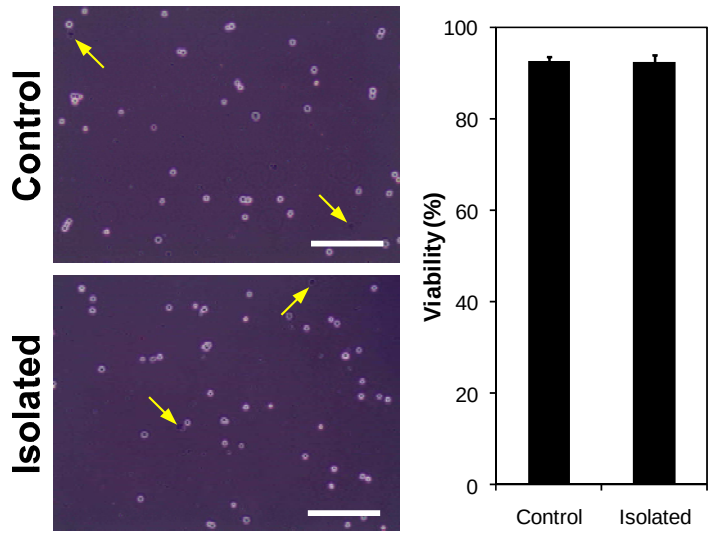
Plot presenting the effect of channel width on collection efficiency of MDA-MB-231 cells for increasing *Re*.

Figure S2.



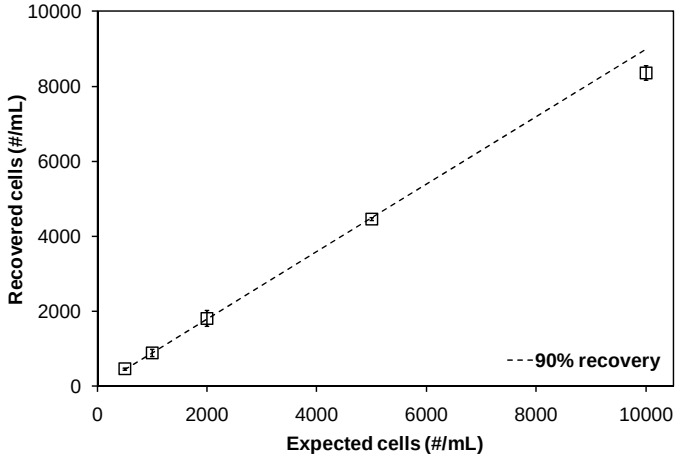
Phase contrast micrographs of cultures of control (unsorted) MCF-7 cells and cells isolated from the center outlet of the microfluidic device. The images indicate no significant differences between the morphology and proliferation rate of the MCF-7 cells suggesting high viability and sterility. bar = 200 µm

Figure S3.



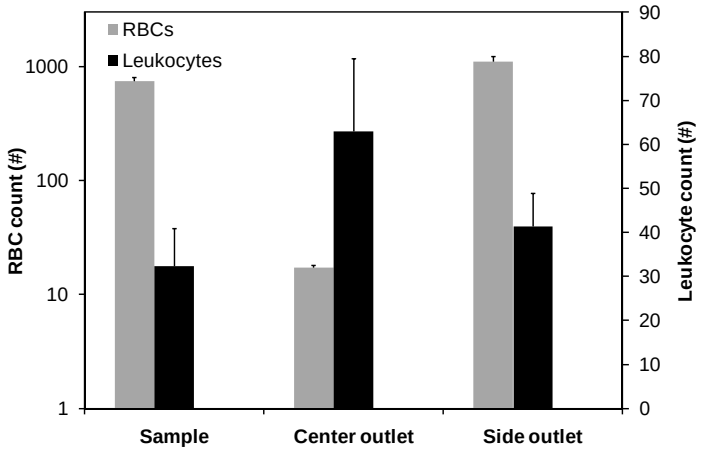
Phase contrast micrographs of control (unsorted) and sorted MCF-7 cells stained using trypan-blue dye indicating cell viability (arrows indicate non-viable cells). The results confirms that the high shear experienced by the cells in these microchannels due to the high flowrates do not compromise their viability, retrieving >90% viable cells. bar = 200 µm

Figure S4.



Plot presenting the number of CTCs recovered as a function of increasing spiking concentrations. The data illustrates ~90% CTC recovery rate.

Figure S5.



Experimental results for leukocyte separation from blood. By simply tuning the width of the pinching region to 8 μm we were able achieve a 100 fold leukocyte enrichment from the center outlet with a single run through the device, demonstrating the versatility of the developed microfluidic device towards other blood separation applications.

SI Movie Legends

Movie 1

High speed video (1 kHz) captured at the outlet region indicating the strong focusing of RBCs into two bands along the channel sidewalls in aspect ratio 3.75 microchannel at *Re* = 100 (1% hematocrit). The video clearly illustrates the emergence of a prominent cell-free region at the center of the microchannel.

Movie 2

High speed video (10 kHz) illustrating the isolation of CTCs at the outlet of the device for experiments conducted with MCF-7 cells spiked in 1.5-2% hematocrit sample at *Re* 100 flows. Due to the high hematocrit (volume fraction), the arrival of CTCs is always accompanied with a few scattered and unfocused blood cells which are also collected at the center outlet. The high RBC density limits our ability to identify PBL in the video.

Movie 3

High speed video (10 kHz) captured at the outlet of the 2nd stage shows complete isolation of the MCF-7 cells from the center outlet. A 5.5 $\log_{10}$ fold CTC enrichment is achieved using a cascaded configuration by connecting two devices in series.

Movie 4

Representative schematic and operation of a 4-channel parallel microfluidic device allowing the processing of ~4 mL of whole blood an hour. The video shows the outlet-section of the microchannel at *Re* 100 flowrate.