Electronic Supplementary Material (ESI) for Lab on a Chip

Supporting information

A microfluidic flow-stretch chip for investigating blood vessel biomechanics

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The wall shear stress calculation

In our experiments, the flow rate was translated to shear stresses based on the Purday approximation [1],

$$\tau = \frac{2\mu Q}{wh^2}\left(\frac{m+1}{m}\right)(n+1)$$

where τ_w is the wall shear stress, μ is the dynamic viscosity of the medium (dyne s/cm^2), Q is the volumetric flow rate (cm^3/s), w is the width of the microchannel (cm), and h is the height of the microchannel (cm), m and n are empirical parameters. In our experiments, width w = 1500 μm (0.15 cm), height h= 500 μm (0.05 cm), and [2] viscosity of the culture medium at 37 ^{o}C is μ = 0.1 dynes/cm^2. For aspect ratio [3] $\alpha = h/w < 1/3$, $m = 1.7 + 0.5\,\alpha^{-1.4} = 4.03$ and $n = 2$. For Q = 0.78 mL min^{-1}, the wall shear stress on cells was calculated and set as 26.25 dyn/cm^2.

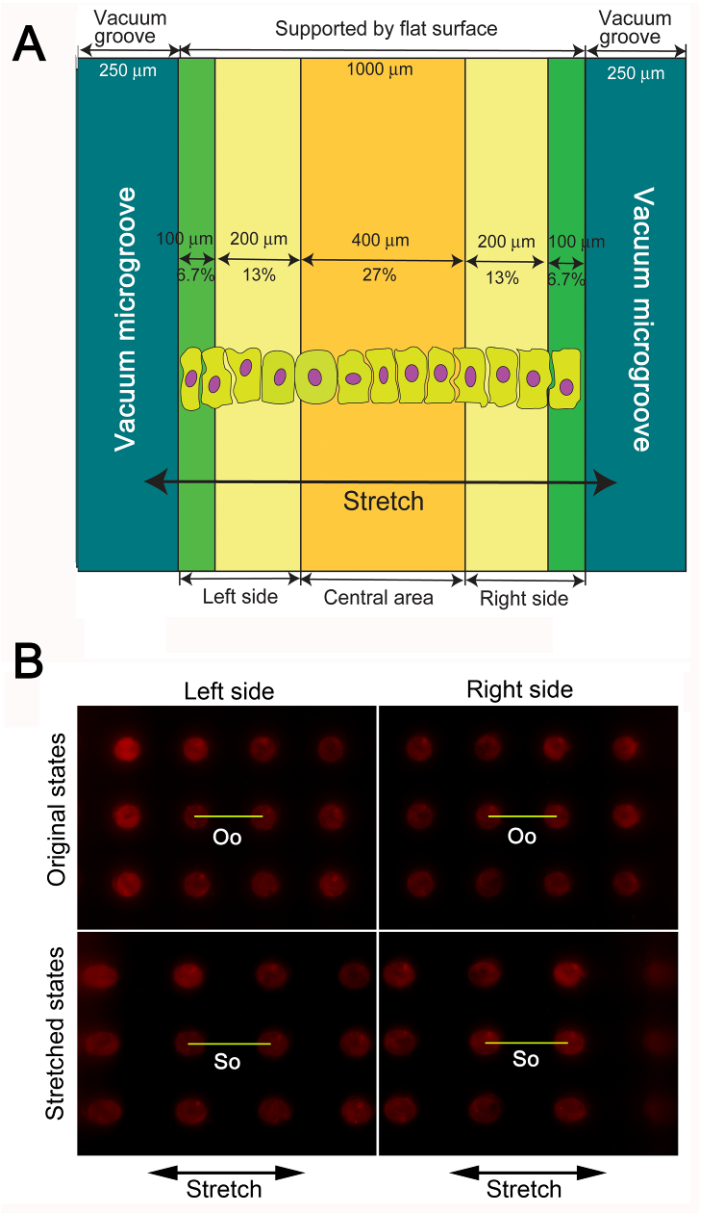

Fig. S1 A) The schematic illustration of elastic membrane in the microchannel. The width of the membrane above the support surface of the stretch layer is about 1000 μm (orange part + yellow part + green part). During the stretching（≥20 %), partial of the two side parts (green part, about 100 μm) of the membrane will slip down to the vacuum microgrooves. So, we measured the deformation of the membrane in the orange (central area, 400 μm) and yellow area (side area, 2×200 μm) in the figure. B) The two side parts of the membrane at original and stretched states. The yellow lines in the images indicate the distance between the neighboring spots at the different states.

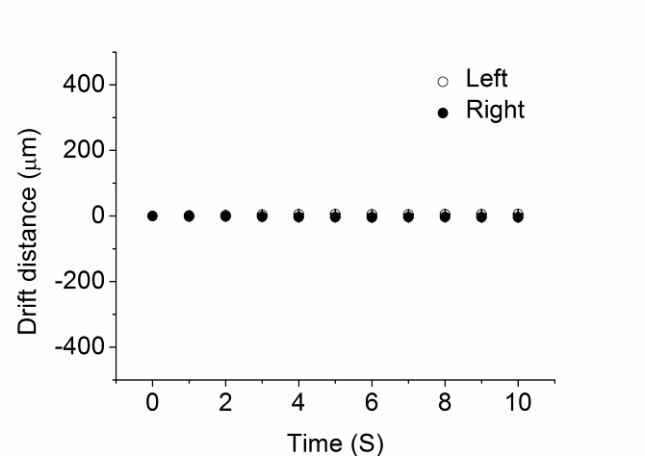

Fig. S2 The traveling trace of the microbeads in the microfluidic channel. The abscissa axis represents traveling time, the vertical axis represents the width of the transverse drift distance of the microbeads. The full scale of the vertical axis is the width of the microchannel (1000 μm). We set the lines passing through the original position of the beads and being parallel to the long axis of the microchannel as the object reference, the deviation to left side was measured as a plus number whereas right side as a minus number. The data show that the paths of the traveling microbeads are almost straight along the long axis of the microchannel.

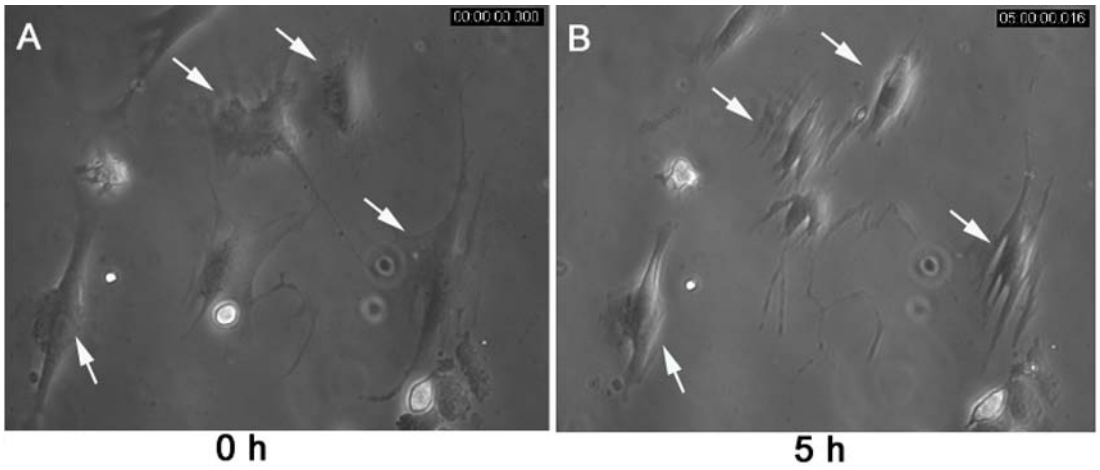

Fig. S3 The morphological remodeling of MSCs before (A) and after 5 hours of FSS-CS stimulation (B).

References

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2. Lee, J. H., Lee, S. G., Khang, G., Lee, H. B., *J Colloid Interface Sci*, 2000, **230**, 84–90.
3. E. W. K. Young, A. R. Wheeler and C. A. Simmons, *Lab Chip*, 2007, **7**, 1759-1766.