Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary Material

ECM-based microchannel for culturing in vitro vascular tissues with simultaneous perfusion and stretch

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1 Theoretical calculation of flows under perfusion and stretch

To perform the flow analysis under perfusion and stretch, the theoretical values of the temporal positions of the microbeads were calculated numerically. The position of the microbeads in the microchannel was temporally changed by combining the inflow perfused by the syringe pump and the inflow/outflow caused by the volume change of the microchannel during the cyclic stretching motion as follows:

- Expanding

$$\frac{dx(t)}{dt} = \frac{Q}{A_{min}} - \frac{q(t)}{A(t)}, \text{ (if } \lfloor 2ft \rfloor = 2k+1) \tag{S1}$$

- Back to origin

$$\frac{dx(t)}{dt} = \frac{Q}{A_{min}} + \frac{q(t)}{A(t)}, \text{ (if } \lfloor 2ft \rfloor = 2k) \tag{S2}$$

where $q(t)$ ($\mu m^3\ s^{-1}$) is the flow rate caused by the volume change of the microchannel during expanding/back to origin and $A(t)$ (μm^2) is the temporal cross-sectional area of the microchannel under stretching motion as follows:

$$q(t) = (x(t)+L)\frac{dA(t)}{dt} = (x(t)+L)\frac{(A_{max}-A_{min})}{\frac{1}{2f}} = 2f(x(t)+L)(A_{max} - A_{min}), \tag{S3}$$

- Expanding

$$A(t) = A_{min} + (t-[t])\frac{(A_{max}-A_{min})}{\frac{1}{2f}} = A_{min} + 2f(t-[t])(A_{max}-A_{min}), \tag{S4}$$

- Back to origin

$$A(t) = A_{max} - (t-[t])\frac{(A_{max}-A_{min})}{\frac{1}{2f}} = A_{max} - 2f(t-[t])(A_{max}-A_{min}). \tag{S5}$$

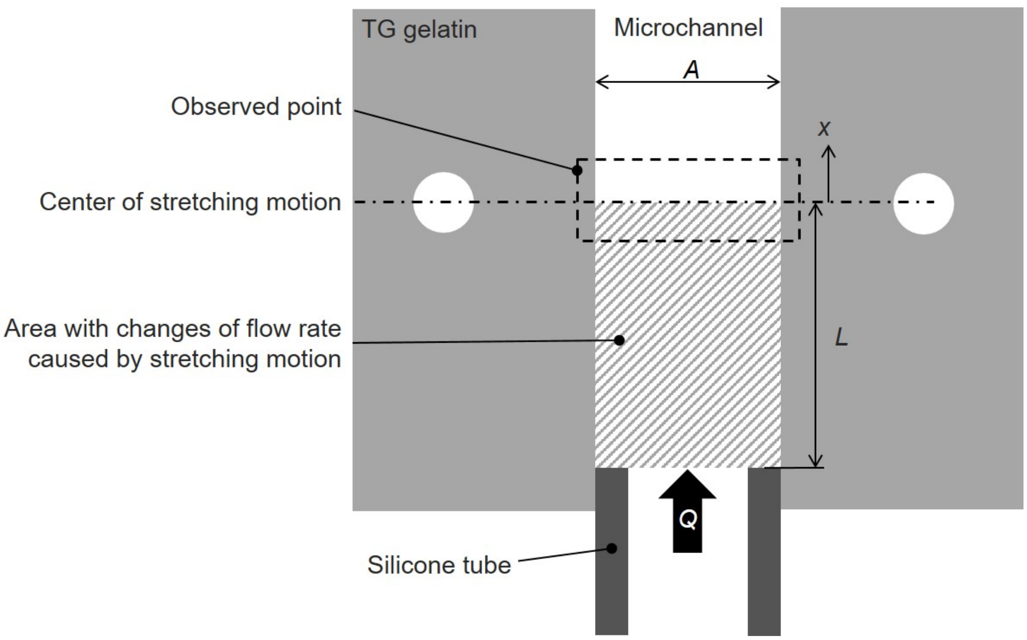
From equations (S1)–(S5), the differential equations related to $x(t)$ are derived as follows:

- Expanding

$$\frac{dx(t)}{dt} = \frac{Q}{A_{min}} - \frac{2f(x(t)+L)(A_{max}-A_{min})}{A_{min}+2f(t-\lfloor t \rfloor)(A_{max}-A_{min})}, \text{ (if } \lfloor 2ft \rfloor = 2k+1) \tag{2}$$

- Back to origin

$$\frac{dx(t)}{dt} = \frac{Q}{A_{min}} + \frac{2f(x(t)+L)(A_{max}\text{-}A_{min})}{A_{max}\text{-}2f(t\text{-}\lfloor t \rfloor)(A_{max}\text{-}A_{min})}, \text{ (if } \lfloor 2ft \rfloor = 2k) \quad (3)$$



Supplementary Figure S1: Definition of flow analysis parameters.