NANO MICRO small

Supporting Information

for *Small*, DOI: 10.1002/smll.201300020

Exhaustion of Racing Sperm in Nature-Mimicking Microfluidic Channels During Sorting

Savas Tasoglu, Hooman Safaee, Xiaohui Zhang, James L. Kingsley, Paolo N. Catalano, Umut Atakan Gurkan, Aida Nureddin, Emre Kayaalp, Raymond M. Anchan, Richard L. Maas, Erkan Tüzel, and Utkan Demirci**

Supporting Figures & Movie

Exhaustion of racing sperm in nature-mimicking microfluidic channels during sorting

Savas Tasoglu [a], Hooman Safaee [a], Xiaohui Zhang [a], James L. Kingsley[e], Paolo N. Catalano [a], Umut Atakan Gurkan [a], Aida Nureddin [a], Emre Kayaalp [b], Raymond M. Anchan [c], Richard L. Maas [d], Erkan Tüzel[e#], Utkan Demirci [a,f#]

[a] *Bio-Acoustic-MEMS in Medicine (BAMM) Laboratory, Center for Bioengineering, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA*

[b] *Jamaica Hospital Medical Center, Department of Obstetrics and Gynecology, Queens, NY, USA*

[c] *Center for Infertility and Reproductive Surgery, Obstetrics Gynecology and Reproductive Biology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA*

[d] *Division of Genetics, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA*

[e] *Department of Physics, 100 Institute Road, Worcester Polytechnic Institute, Worcester, MA 01609*

[f] *Harvard-Massachusetts Institute of Technology Health Sciences and Technology, Cambridge, MA, USA*

[#] Corresponding author:
Utkan Demirci, PhD
Tel. 650-906-9227; Fax: 617-768-8202
E-mail address: udemirci@rics.bwh.harvard.edu

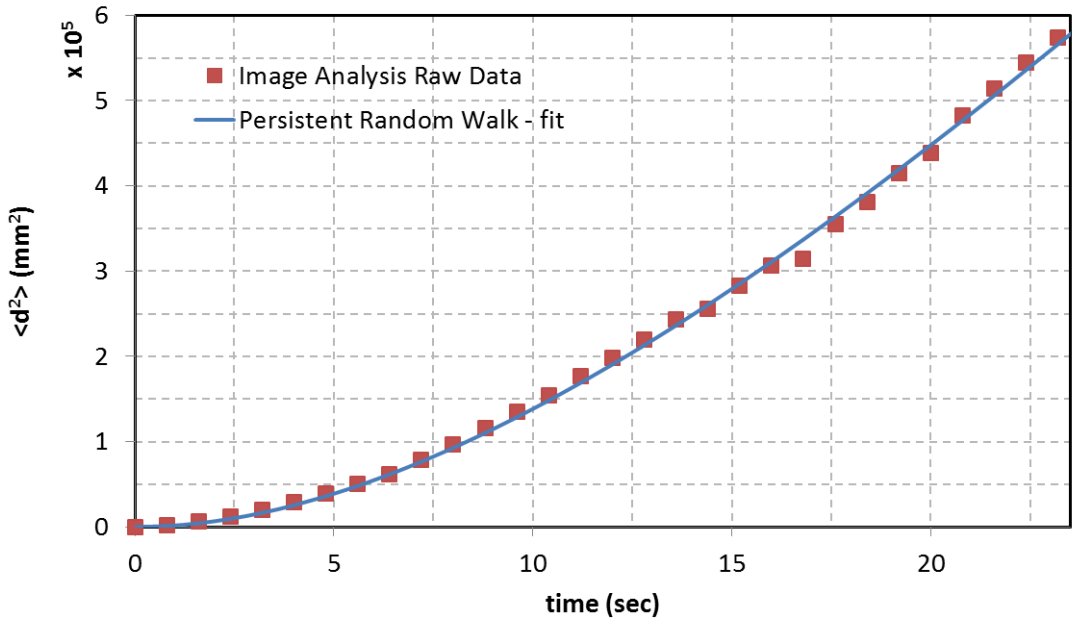

Fig. S1. Image analysis was performed for 20 sperm tracks (as illustrated in Fig. 1E), and the mean-squared-displacements (MSD) were calculated. The resulting averaged MSDs were then fitted to the persistent random walk (PRW) model (see Eq. (2)).

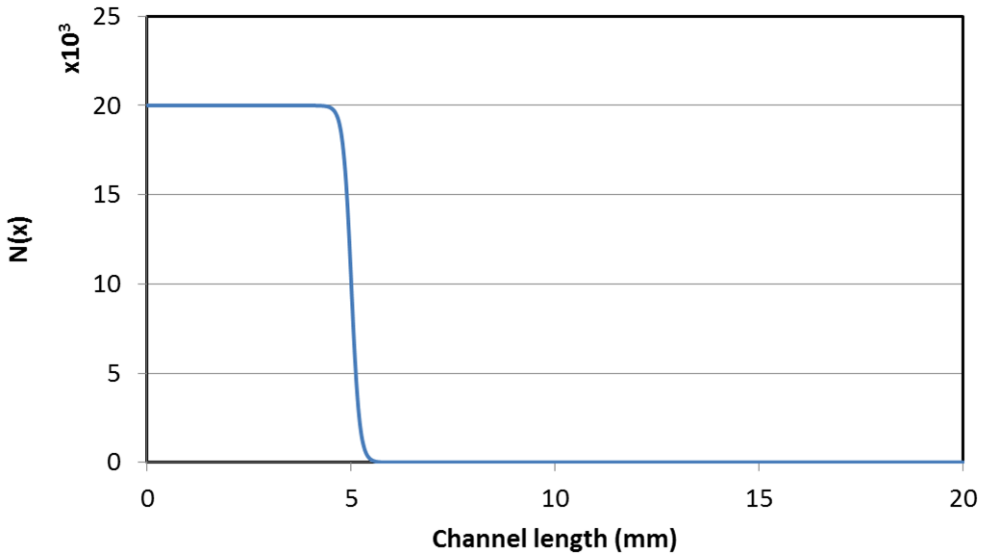

Fig. S2. Distribution N(x) of sperm as a function of channel length. A Fermi-like distribution, as discussed in Ref. [42], is used (see Eq. (9)). The mean interface location, μ, is chosen to be 5mm, and the sharpness parameter β = 10 mm^{-1}. The total number of sperm in the channel, N_T, is 10^5.

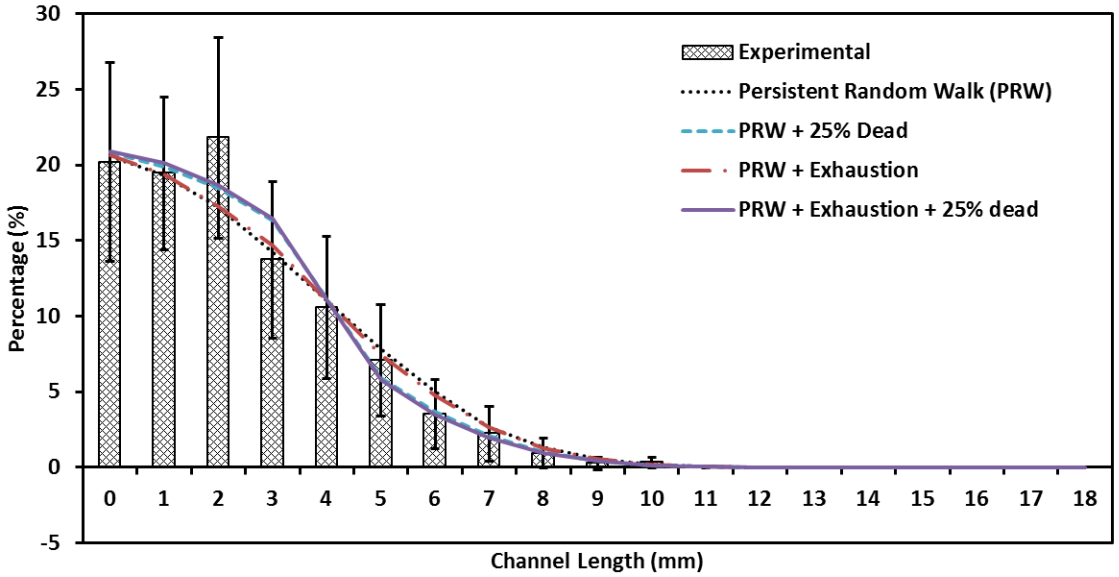

Fig. S3. Comparison of experimental and simulated sperm distributions after incubation for 5 minutes. Experimental results are compared with computational models: (1) Persistent Random Walk (PRW), (2) PRW and initially 25% of sperm are dead, (3) PRW including 30 minutes exhaustion time of sperm (± 15 minutes), and (4) PRW including both exhaustion time and initially 25% dead. Data were presented as average ± standard error.

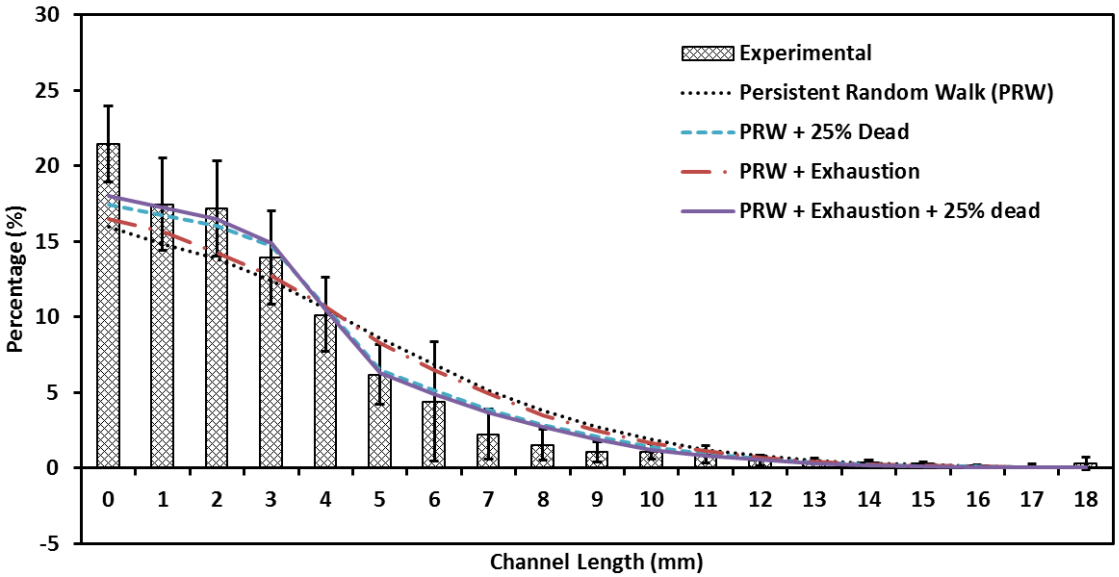

Fig. S4. Comparison of experimental and simulated sperm distributions after incubation for 15 minutes. Experimental results are compared with computational models: (1) Persistent Random Walk (PRW), (2) PRW and initially 25% of sperm are dead, (3) PRW including 30 minutes exhaustion time of sperm (± 15 minutes), and (4) PRW including both exhaustion time and initially 25% dead. Data were presented as average ± standard error.

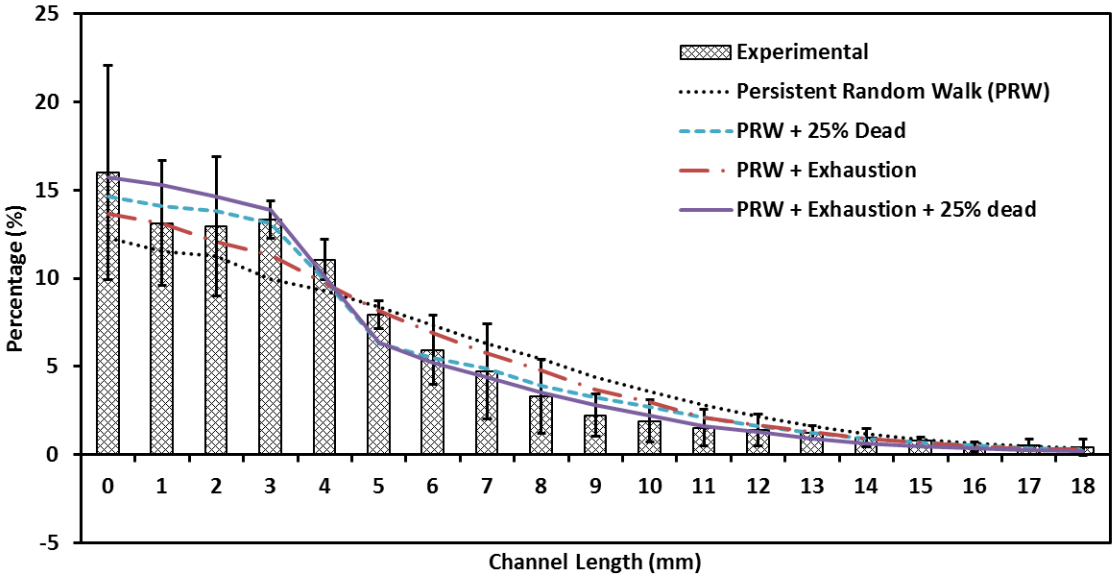

Fig. S5. Comparison of experimental and simulated sperm distributions after incubation for 30 minutes. Experimental results are compared with computational models: (1) Persistent Random Walk (PRW), (2) PRW and initially 25% of sperm are dead, (3) PRW including 30 minutes exhaustion time of sperm (± 15 minutes), and (4) PRW including both exhaustion time and initially 25% dead. Data were presented as average ± standard error.

Supporting Movie. A visualization of the simulated sperm swimming in a microchannel. Sperm use the persistent random walk model described in the paper, with S = 42 μm/s, P = 13 s, and N = 1000. Exhaustion is set to 30 minutes with a standard deviation of 15 minutes, and 25% of the starting sperm are non-motile. Each frame corresponds to one second, for a total time of one hour.