Simulation of red blood cells flowing over wall-bound cells AMIR H.G. ISFAHANI, University of Illinois at Urbana-Champaign, HONG ZHAO, Stanford University, JONATHAN B. FREUND, University of Illinois at Urbana-Champaign — Inter-cellular dynamics play a critical role in the phenomenology of the microcirculation. We present a quantitative investigation of the forces exerted by red cells on protrusions on a microvessel of diameter around 12 \( \mu \text{m} \), which is 1.5 times the longest dimension of a red cell at rest. This configuration serves as a model for white blood cells (leukocytes), which can bind nearly statically to the endothelial cells as part of the inflammation response. The simulation tools are based on an \( O(N \log N) \) boundary integral formulation. It permits the cells to both be realistically flexible and to approach to very close separation distances. The red blood cells are modeled as finite-deformation elastic membranes with strong resistance to surface dilatation and relatively small but finite resistance to bending. The no-slip condition is applied on the protrusion as well as the vessel walls. Simulation results show that these forces are significantly augmented by the particulate character of blood. For a tube hematocrit of 30\% and a hemispherical protrusion with a height to tube diameter ratio of 0.4, the average forces are increased by about 50\% and the local forces by more than two folds relative to forces from an effective viscosity homogenized blood. Different flow configurations are considered and analyzed.