Anomalous diffusion and q-Weibull velocity distributions in epithelial cell migration

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In multicellular organisms, cell motility is central in all morphogenetic processes, tissue maintenance, wound healing and immune surveillance. Hence, the control of cell motion is a major demand in the creation of artificial tissues and organs. Here, cell migration assays on plastic 2D surfaces involving normal (MDCK) and tumoral (B16F10) epithelial cell lines were performed varying the initial density of plated cells. Through time-lapse microscopy quantities such as speed distributions, velocity autocorrelations and spatial correlations, as well as the scaling of mean-squared displacements were determined. We find that these cells exhibit anomalous diffusion with q-Weibull speed distributions that evolves non-monotonically to a Maxwellian distribution as the initial density of plated cells increases. Although short-ranged spatial velocity correlations mark the formation of small cell clusters, the emergence of collective motion was not observed. Finally, simulational results from a correlated random walk and the Vicsek model of collective dynamics evidence that fluctutions in cell velocity orientations are sufficient to produce q-Weibull speed distributions seen in our migration assays.