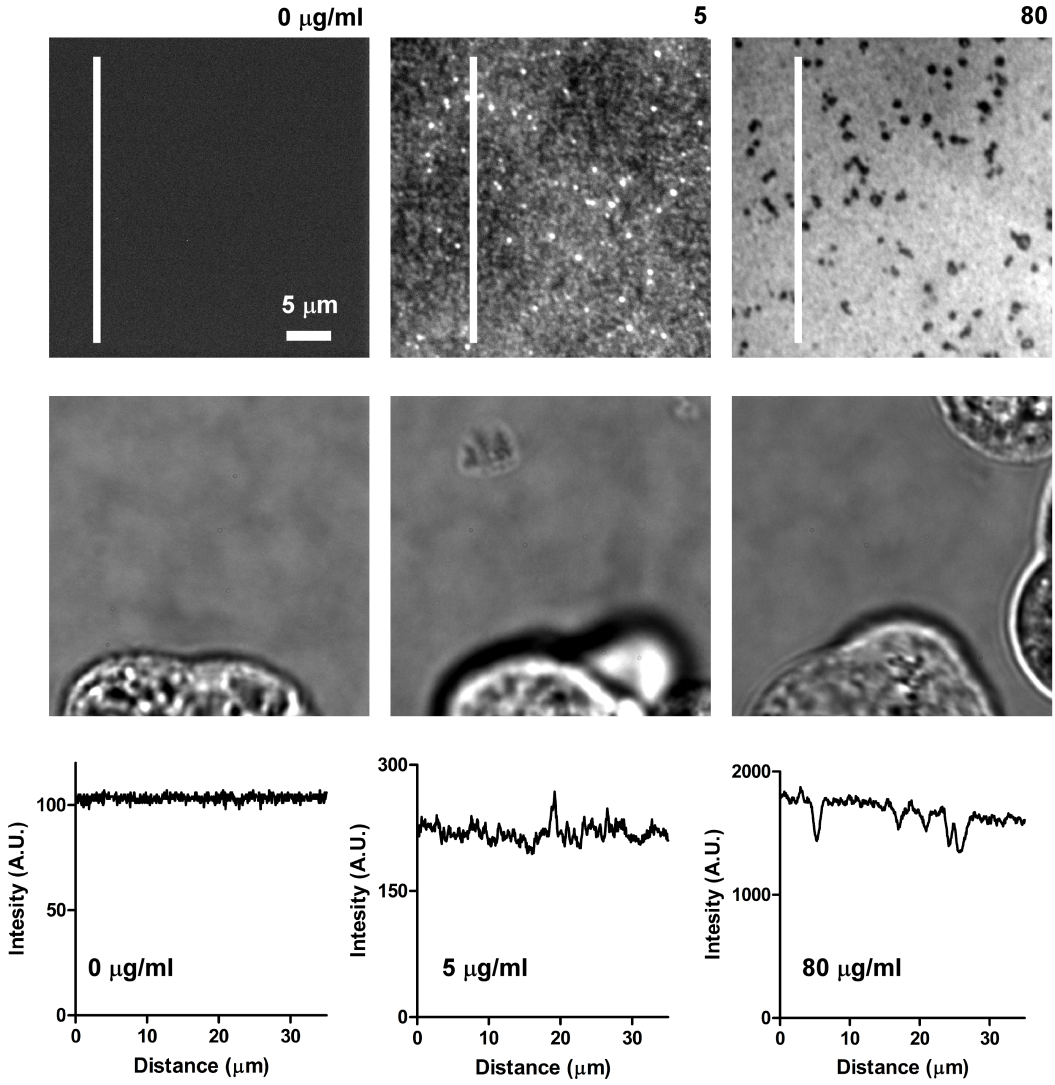
Electronic Supplementary Material (ESI) for Integrative Biology.

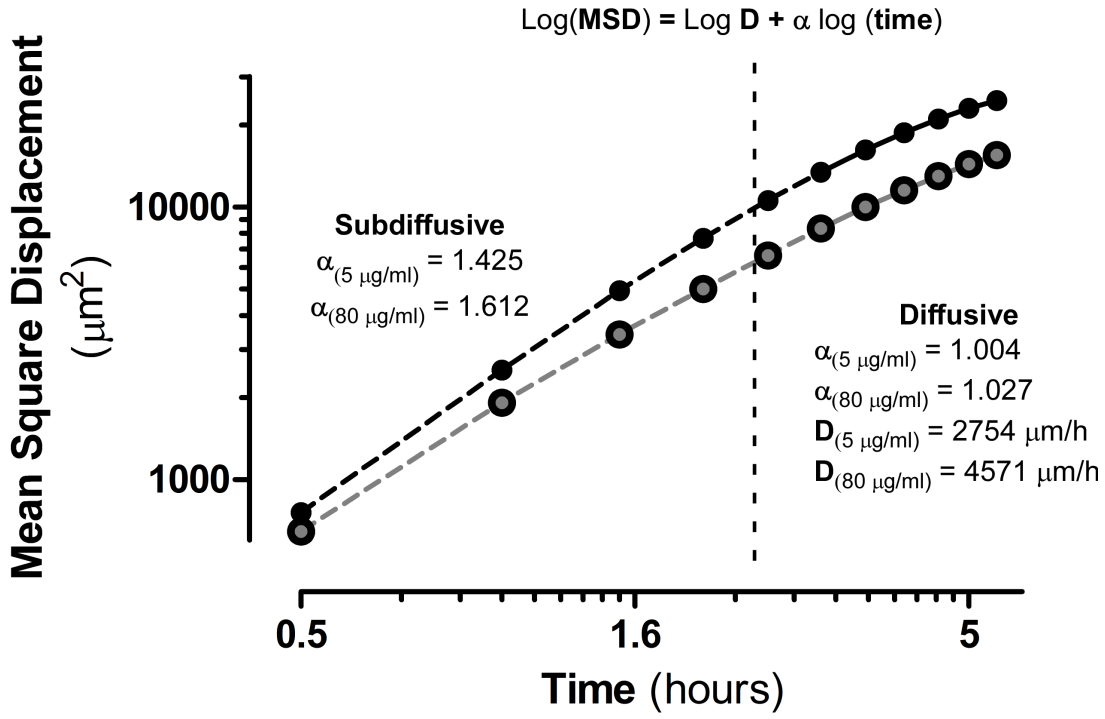
Regulation of epithelial cell organization by tuning cell-substrate adhesion.

Supplemental Materials

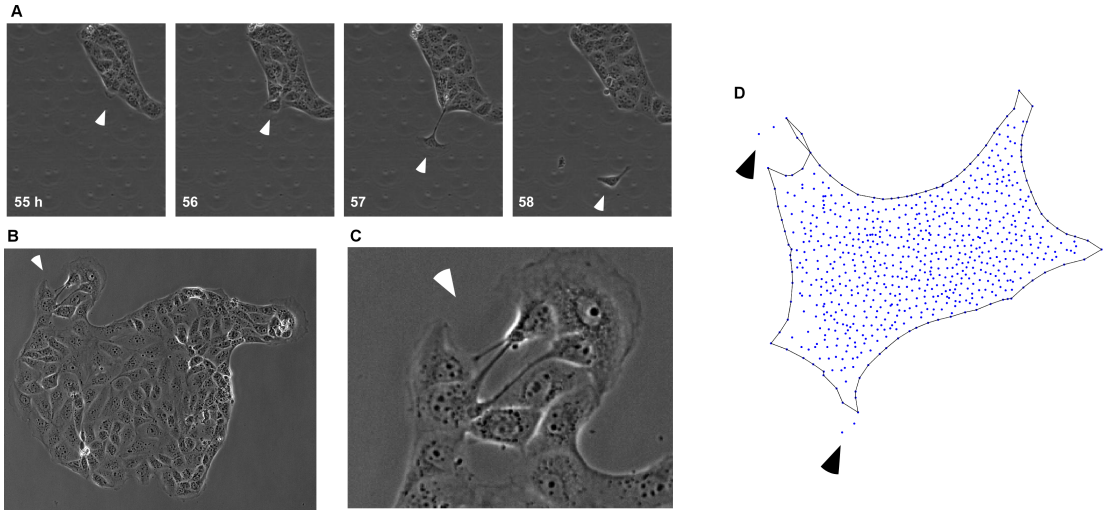
Supplementary figures.



Suppl. Fig. 1 – High resolution images of fibronectin coated glasses. Images were acquired using and Olympus IX81 equipped with an oil immersion 100x objective (1.3 NA). Top – fluorescence images of Fibronectin conjugated with Cy5 dye. Middle – corresponding DIC images show the localization of cells. Bottom – intensities line profiles along the white lines in the corresponding fluorescence images demonstrate the level of fluorescence intensity. Micrometer-size inhomogenities are also detectable. Images have been acquired one day after cell seeding.



Suppl. Fig. 2 – Log-log plot of averaged Mean Squared Distance of individual SNAIL cells on 5 vs 80 ug/ml. Each plot is fit by two separate linear curves in two regimes (separated by dotted line). Gradient of linear curves, α, shows type of motion, with $\alpha > 1$ being subdiffusive regime, and $\alpha \sim 1$ being diffusive regime. For diffusive regime, y-intercept of linear curves shows log of diffusion coefficient.



Suppl. Fig. 3 – **A**. Time laps of one cell leaving the cell colony. **B**. Example of leader cell partially detaching from the follower and causing gaps in the tissue. **C**. Enlarged view of B. For A, B and C, colonies were grown on 80 µg/ml FN. **D**. Prediction of cell detachment in the model.

Tables.

Name of force	Description	Directionality	Biological interpretation
F_interaction	Reciprocal repulsion of cells being too close to each other and attraction of cells moving away from each other. The attractive part of the inter-particle potential, representing cell-cell contact adhesion, has an upper cut-off beyond which cells are assumed not to be in contact.	Outward (repulsive) at high cell density. Inward at low density.	Applied to all cells. Repulsion is due to compression of cytoplasm; attraction is due to CCJ adhesiveness.
F_vicsek	Velocity alignment between neighboring cells. Describes the collective (swarming) behavior of cells that tend to adopt the same directionality of motion as that of their nearest neighbors.	Follow the directionality of movement of the cells and tend to align their polarity vectors.	Applied to all cells. Shear and normal forces acting at the CCJ tend to align directionality of movement.
F_noise	Random force with certain correlation (persistence) time, representing the fact that cells are self-propelled particles. This force does not depend on the neighboring cells.	Random. However, combined to F_interaction leads to outward average movement.	Applied to all cells. Describe random crawling mechanism.
F_friction	Friction force resulting from interaction with the surface. The value is proportional to the velocity and direction is opposite to velocity.	Not applicable	Applied to all cells. Adherence of cell to the substrate. Its strength depends on FA dynamics.
F_bending	Forces acting on the cells at the colony's edge that counteracts any deformation (i.e. line tension). This is a restoring force of the effective 1D membrane of the cells' edge.	Inward in case of convex boundary. Outward at concave curvatures.	Applied to the boundary. Pulling of the actomyosin cable tend to dissipate the curvature at the edge.
F_border	Active instability force,	Outward	Applied to the

	derived from cell crawling through extension of a lamellipodia towards the free surface. It is applied only to cells at the colony's edge that have convex curvature, and is proportional to the size of this curvature: the more highly curved the edge cell the larger is this outwards-directed traction force.		boundary. Describes the effect of leader cells' ability to crawl faster than the bulk cells and drive the growth of fingers. The cells at the most highly curved tips of such fingers behave as "leader cells".
F_cable	Actomyosin cables apply additional attraction (contractile) force between edge cells. We apply this force only in regions with concave curvature or slightly convex curvature, as is observed in experiments.	Inward in case of convex boundary. Outward for concave curvatures.	Applied to the boundary. Contractility of the acto-myosin cable along the edge of the cell colony.

Table S1 – Summary of forces terminology, description, effect on the colony dynamics and biological significance.

Supplementary movie legends.

Suppl. Movie 1, **2** and **3** – Movies show the expansion of cell colonies at 0, 5 and 80 μg/ml of FN, respectively. Time lapses of these exemplary experiments can be found in Fig 2A, main text. Frames are acquired every 30 min. Whole movies show evolution of the colonies from day 1 to day 5.

Suppl. Movie 4 and **5** – Movies show PIV quiver representation of field velocities of colonies grown on 5 and 80 μg/ml of FN, respectively. Time lapses of these exemplary experiments and color coding can be found in Fig 2A - E, main text. Frames are acquired every 30 min. Whole movies show evolution of the colonies from day 1 to day 5.

Suppl. Movie 6 – Example of one cell leaving the colony. Cell colony was cultured on 80 μg/ml of FN. Frame rate = 1 image every 30 min.

Suppl. Movie 7 and **8** – Movies shows traction force microscopy of cell colonies grown on 5 and 80 μg/ml of FN, respectively. Quiver of beads displacement is over-imposed on GFP-Actin fluorescence images. Frame rate = 1 image every 10 min.

Suppl. Movie 9 and **10** – Movies show PIV quiver representation of α-caternin KD colonies grown on 5 and 80 μg/ml of FN, respectively. Color coding can be found in Fig 2C, main text. Frames are acquired every 30 min. Whole movies show evolution of the colonies from day 1 to day 5.