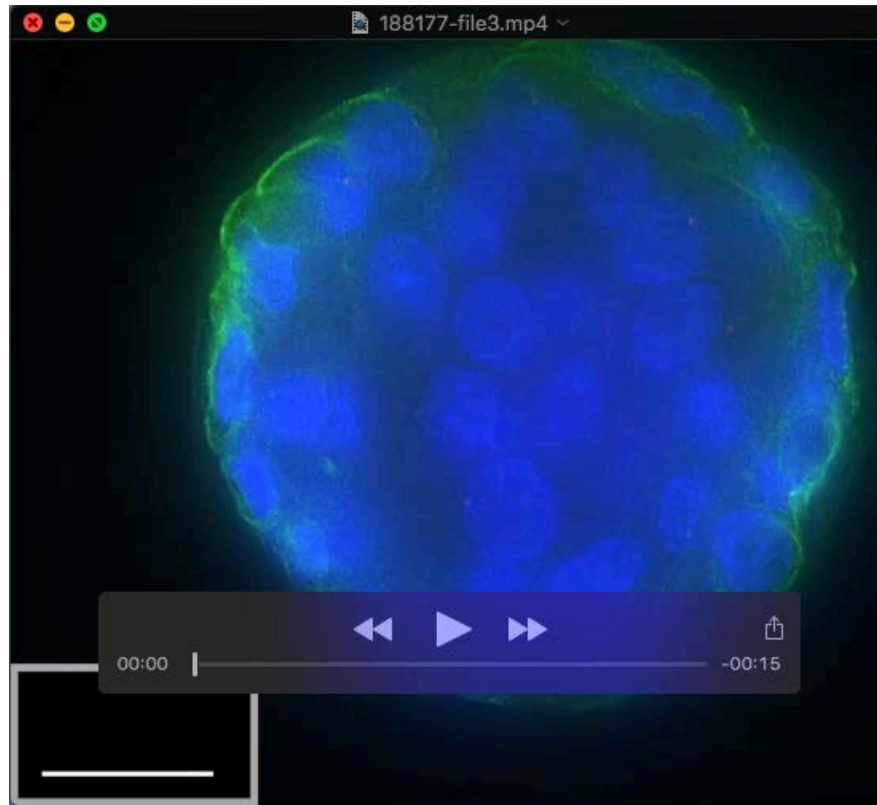




Supplementary Movie 1. 3D model of PIN arises from single cells. Movie was taken 2 hours after RWPE-1 cells were seeded on the Matrigel for 64 hrs. Notice that instead of moving into each other, single cells were dividing and rotating to form the structure.



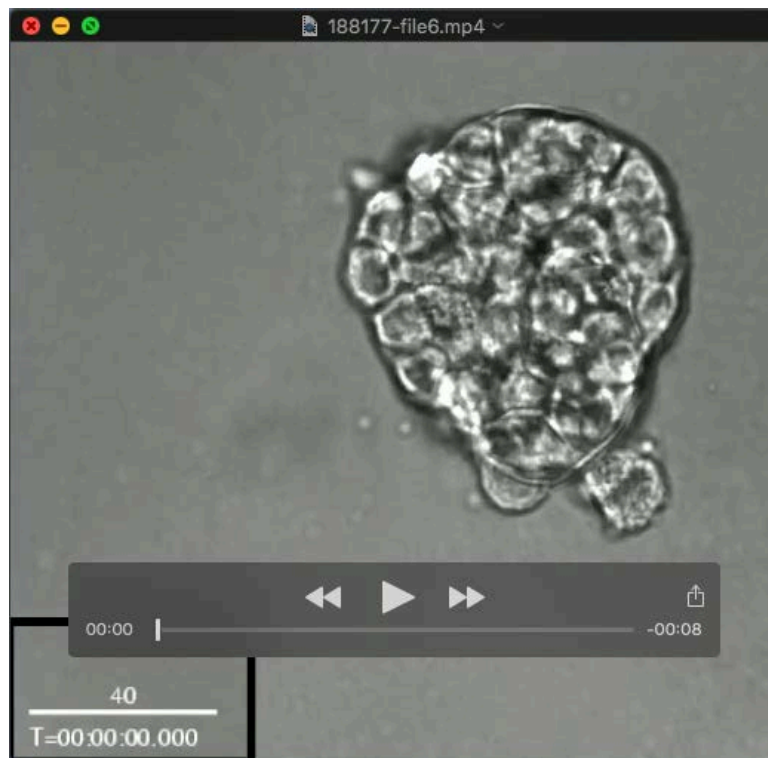
Supplementary Movie 2. Rotational motion during spheroid formation. Movie was taken 5 days after RWPE-1 cells seeded in 3D culture for 60 hrs. Notice that the whole spheroid was rotating while the cells were dividing, and the rotation motion stopped approximately at 50 hrs.



Supplementary Movie 3. Spindle orientation of the basal cells in spheroid. Representative Z stack of a day 10 RWPE-1 spheroid immunostained with CEP135 (Red) as a centrosome marker and α -tubulin (green) with 0.2 μ m step size. Scale bar = 15 μ m.



Supplementary Movie 4. Mature WT RWPE-1 spheroid formation without invasive phenotype. Movie was taken 12 days after RWPE-1 cells were seeded in 3D culture for 37 hrs.



Supplementary Movie 5, 6. Mature $\beta 4$ integrin minus RWPE-1 spheroid with cohesive budding. Movie was taken 12 days after RWPE-1 cells were seeded in 3D culture for 37 hrs.