# Microbes Under Pressure

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When cells grow in crowded environments, such as biofilms, organs or tumors, they need to push their surroundings to accommodate space for new cells. The magnitude of the resulting mechanical forces and their bio-physical consequences have remained difficult to study using common in vitro techniques that lack mechanical control. Using a novel microfluidic chemostat, we show that populations of budding yeast can develop highly fluctuating mechanical pressures in the MPa range when they are growing in leaky cavities. The growth-induced compressive stresses strongly modify the shape and dynamic arrangement of the cells and slow down their growth rates, correlated with a cell cycle arrest in the G1 phase. By using the cell shape deformation as an indication for locally acting mechanical stresses, we show that dense cell packings are mechanically stabilized by heterogenous force networks with 'force-chains' spanning numerous cells. These force networks are interrupted and reformed by sudden collective rearrangement events with a broad distribution of magnitudes that allow cells to flow out of the leaky cavity. These features strikingly resemble those of driven granular materials and can be reproduced in overdamped simulations of proliferating soft particles. In both experiments and simulations, cell-cell cohesion strongly promotes jamming-induced clogging of confined spaces. The self-driven jamming and build-up of significant mechanical pressures could thus be a natural tendency of microbes growing in confined spaces, and possibly contribute to microbial pathogenesis, biofilm formation, and biofouling.