**Physical principles of membrane remodelling during cell mechanoadaptation**

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Biological processes in any physiological environment involve changes in cell shape, which must be accommodated by their physical envelope – the bilayer membrane. However, the fundamental biophysical principles by which the cell membrane allows for and responds to shape changes remain unclear. Here we show that the 3D remodelling of the membrane in response to a broad diversity of physiological perturbations can be explained by a purely mechanical process. This process is passive, local, almost instantaneous, prior to any active remodelling, and generates different types of membrane invaginations that can repeatedly store and release large fractions of the cell membrane. We further demonstrate that the shape of those invaginations is determined by the minimum elastic and adhesive energy required to store both membrane area and liquid volume at the cell-substrate interface. Once formed, cells reabsorb the invaginations through an active process with duration of the order of minutes.