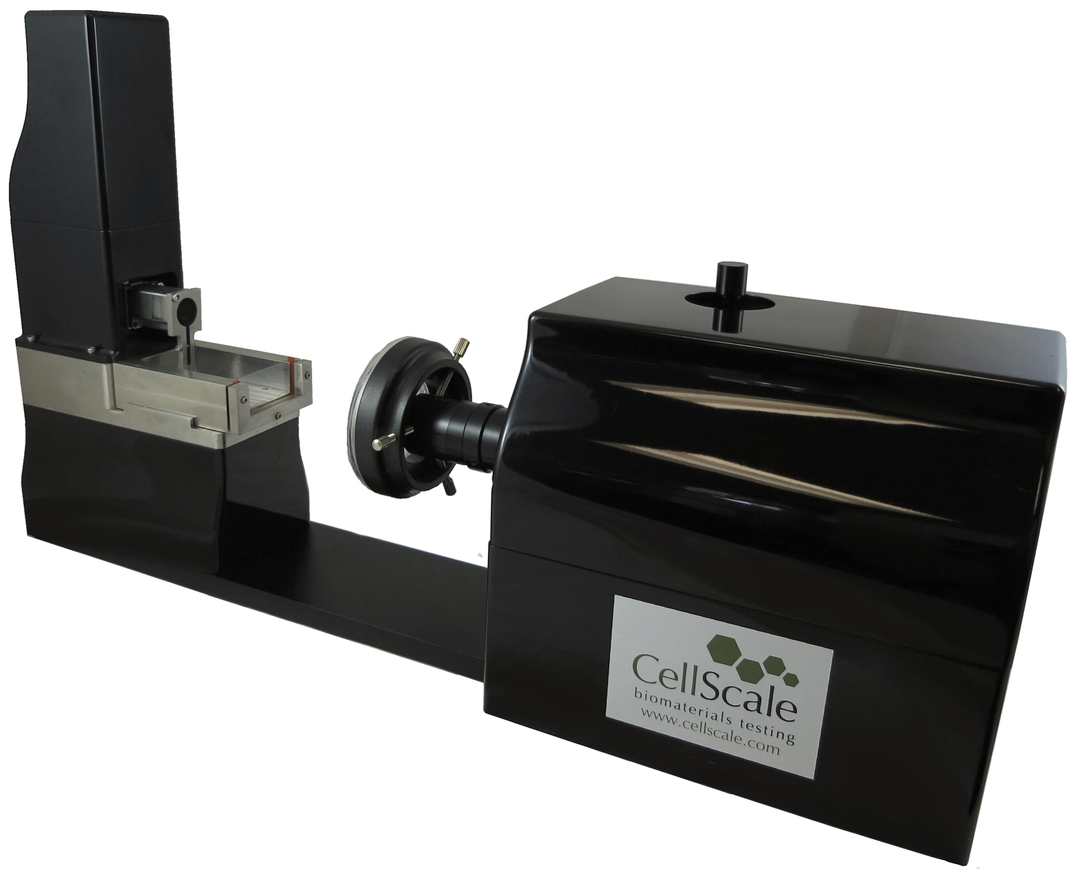
# Cell Aggregate (Spheroid) Compression Testing

## Overview

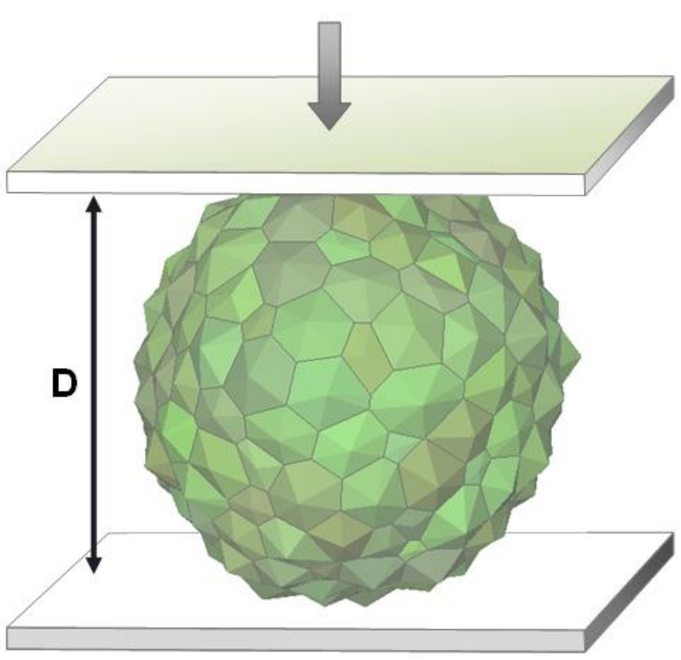
The MicroSquisher has been designed to perform tension and compression testing at low forces. Properties that can be measured when a spherical aggregate of cells is compressed between parallel plates (Fig. 1) include cell viscosity and surface and interfacial tensions. These properties are important because they determine how cells and tissues self-organize during embryogenesis, wound healing, regenerative medicine, and cancer metastases. The compression test provides a controlled mechanical environment in which the aggregate and its cells are deformed. By monitoring the geometry of the aggregate (Fig. 1B) and the time course (Fig. 2) of the force the aggregate exerts on the compression plates, one can determine the effective viscosity of the cytoplasm in the cells, the strength of the interfacial

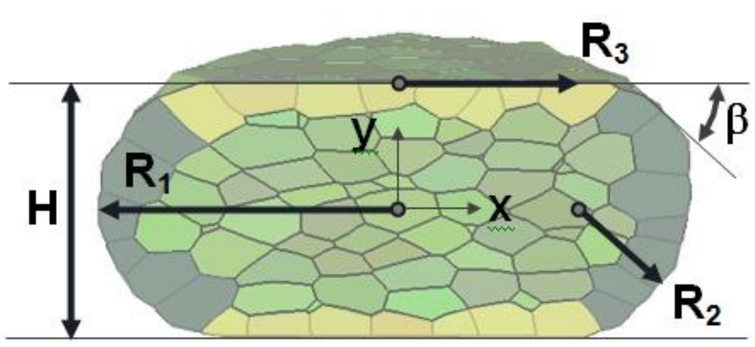



tension that acts along each cell-cell boundary (Fig. 3) and the strength of the surface tension present along the cell-medium interface[3].

## The Compression Test

In a typical compression test, a spherical aggregate of cells is placed between parallel plates. The plates are then moved together under and the aggregate is compressed. The this case, the compression is typically carried out relatively rapidly (over several seconds) and, as a result, individual cells in the aggregate deform as the aggregate deforms.



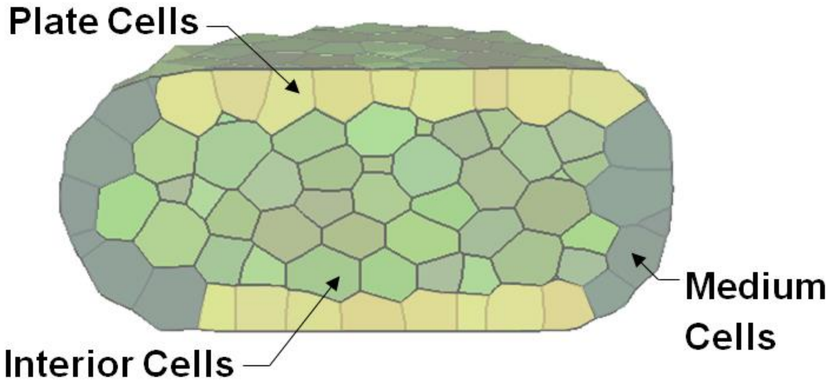




Fig. 1 – The compression process. Immediately following compression, the aggregate and its cells are visibly deformed. After annealing, the cells become nearly isotropic in shape again, but the aggregate remains compressed (from Brodland et al., 2009).

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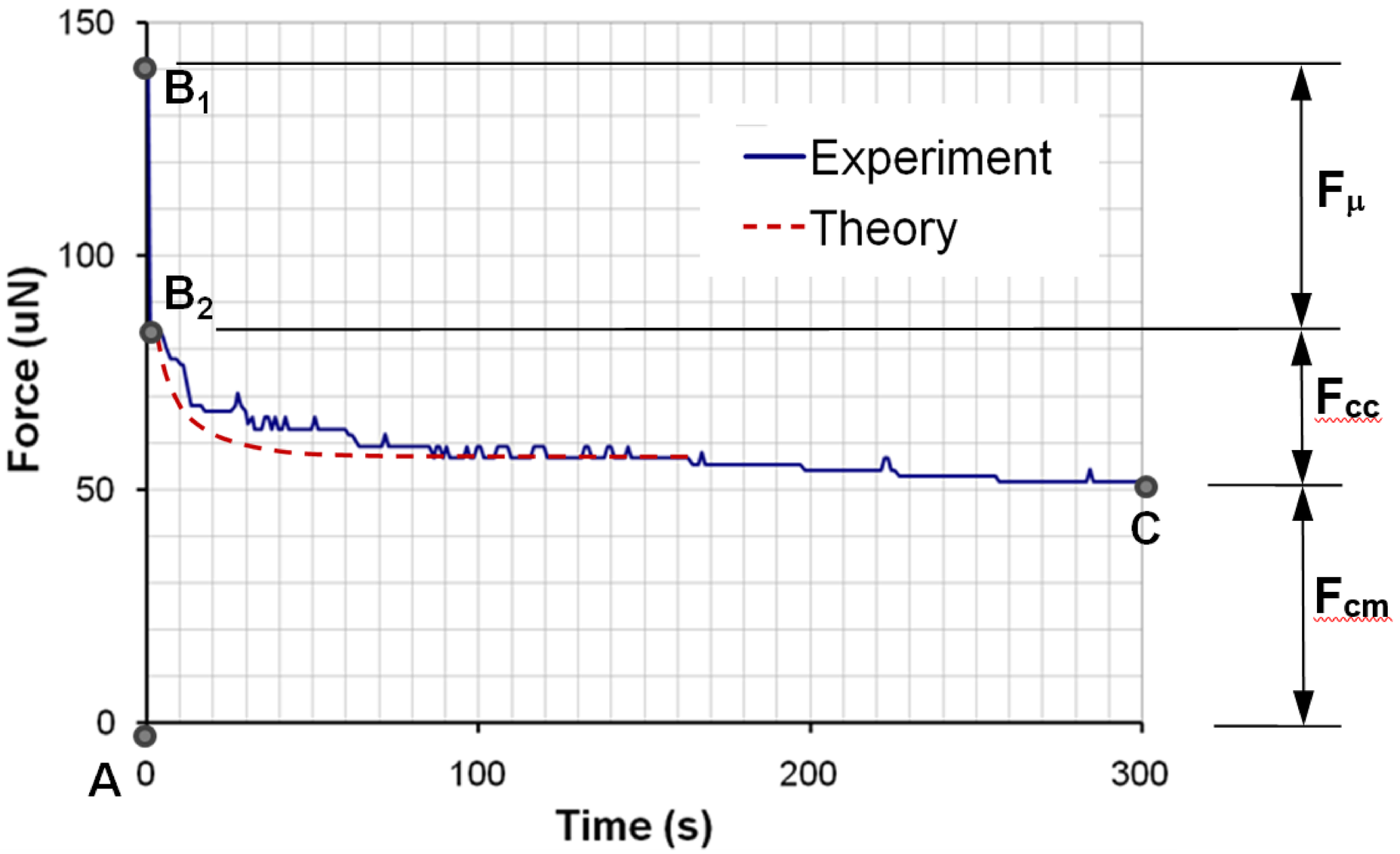
With time, the cells reshape and reorganize within the aggregate and the platen force decreases. Specific parts of the force-time curve can be associated with particular cell properties[2,3,5]. Specifically, the effective viscosity of the cells (μ) can be determined from Fμ, the rapid decrease in force from B1 to B2. The force decay Fcc from B2 to C is caused by reshaping of the cells inside the aggregate, and it can be used to calculate the cell-cell interfacial tension γcc. The steady-state force Fcm provides data for calculating the cell-medium and cell-platen interfacial tensions γcm and γcp, respectively. These surface and interfacial tensions arise from the action of various sub-cellular mechanical components including acto-myosin systems, membrane contractions and cell-cell adhesion systems[1,4], and the measured forces can be used to quantify their mechanical activity.





1. Brodland GW (2002) DOI: 10.1115/1.1449491
2. Brodland GW. (2003) *Biorehology* 40, 273-277
3. Brodland GW et al. (2009) DOI: 10.2976/1.3175812
4. Lecuit and Lenne (2007) DOI: 10.1038/nrm2222
5. Yang and Brodland (2009) DOI 10.1007/s10439-009-9649-6

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