Abstract Submitted
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Mechanical role of phospolipid bilayers in synovial joint lubrication[1] ROSS PACKARD, YVES DUBIEF, LEONIE COWLEY, School of Engineering, University of Vermont, Burlington VT — Cartilaginous surfaces in synovial joints have been shown to be coated by multilamellar water and phospholipid bilayer arrangements. The interactions between the bilayers and synovial gel composed of hyaluronic acid (HA) and albumin forms the basis of the SAPL (surface active phospholipids) theory to explain joint lubrication. While considerable efforts have been devoted to the rheological properties of synovial gel, the ability of SAPL to sustain significant mechanical stress has received little attention. Using Gromacs molecular dynamics (MD) solver, we have characterized the response to compression and shear of multilamellar arrangements composed of water and dipalmitoylphosphatidylcholine (DPPC, a phospholipid in highest concentration in synovial fluid). MD simulations were performed with and without HA to isolate the dynamics that allow the multilamellar arrangement to retain its anisotropic structure beyond the normal gait pressure of 1.5 MPa. The critical normal compression that provokes the rupture of membranes and drainage of the system is a strong function of the thickness of the water layer and may exceed 15MPa due to complex underlying membrane dynamics.

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