Direct force and distance measurements between two lipid bilayers and effects of membrane proteins

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The myelin sheath is a multilamellar membrane which concentrically wraps around the axons of neurons. Myelin basic protein (MBP) is one of the essential proteins determining myelin structure, strongly holding the cytoplasmic leaflet side (major dense line) together by electrostatic and hydrophobic interactions. Defects or disruptions in the myelin bilayers increase the capacitance, which could lead to changes in nerve signal conduction, resulting in sensory and motor disabilities. Multiple sclerosis (MS) is the most common progressive neurological disorder and is characterized by the appearance of the lesions in myelin, reflecting loss of bilayer adhesion, swelling across the water gaps, vacuolization, vesiculation, and eventual disintegration of the myelin sheath.
Using a surface forces apparatus (SFA)., we studied the effect of lipid composition (which effects lipid domain size and distribution) on the MBP adsorption which essentially effects inter-membrane adhesion. We found that a slight change in lipid composition from healthy to EAE (experimental autoimmune encephalomyelitis: a disease model of multiple sclerosis) caused abnormal adsorption of MBP between myelin bilayers, eventually leading to significant swelling of the system and also a decrease in inter-membrane adhesion.