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A combination of AFM and high resolution X-ray scattering studies combined with atomistic MD simulation provides microscopic insight into the mechanism of PETIM dendrimer-membrane interaction and consequent membrane re-organization as well as parameters controlling formation of membrane pore formation. By tuning the packing of lipid molecules through controlled changes in effective mean molecular area we have shown how penetration and pore formation by PETIM G4 can be controlled. We observe, to our knowledge for the first time very regular and well defined barrel-like structure of the pores formed by membrane bound dendrimers, without actually disrupting the integrity of the membranes.