Molecules and mechanics of cell adhesion studied by AFM force spectroscopy

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Cell adhesion is a complex process regulated by a number of surface proteins as well as cytoskeleton structure. The former has been recognized to mainly contribute molecular force, while latter governs the mechanical properties (e.g. elasticity) involved in cell adhesion. The importance of characterizing cell surface molecular binding events altered by protein ligation as well as cell elasticity changed due to cytoskeletal re-organization in response to TGF-β1 treatment has recently been highlighted by the authors [1]. Atomic force microscopy force spectroscopy (AFM-FS) has been demonstrated to be a powerful tool for the quantitative study of both single cell elasticity and surface molecular binding [2]. In this study, we have applied AFM-FS to measure detachment energy, unbinding force between two adherent HK2 cells as well as the elasticity and viscoelasticity of the cells. In combination with single cell indentation test, the measured force-displacement curve of the separation process of the two cells reveal the change of adhesion characteristic contributed from both the surface molecular binding and cell elasticity/viscoelasticity. Moreover, a new model has been proposed to correlate the surface molecular adhesion with single cell mechanics, which may be useful for the fundamental understanding of disease progression and the development of new therapies [3].

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[3] R. G. Wells, Biochim Biophs Acta 1832, 884 (2013)