Biophysical Journal, Volume *110*

Supplemental Information

Micromechanical Analysis of the Hyaluronan-Rich Matrix Surrounding the Oocyte Reveals a Uniquely Soft and Elastic Composition

Xinyue Chen, Rita Bonfiglio, Suneale Banerji, David G. Jackson, Antonietta Salustri, and Ralf P. Richter

Biophysical Journal

Supporting Material

Micromechanical Analysis of Hyaluronan-Rich Matrix Surrounding the Oocyte Reveals a Uniquely Soft and Elastic Composition

Xinyue Chen,[1,2] Rita Bonfiglio,[3] Suneale Banerji,[4] David G. Jackson,[4] Antonietta Salustri,[3] and Ralf P. Richter[1,2,5,*]

[1]CIC biomaGUNE, San Sebastian, Spain; [2]Max Planck Institute for Intelligent Systems, Stuttgart, Germany; [3]Department of Biomedicine and Prevention, Faculty of Medicine, University of Rome Tor Vergata, Rome, Italy; [4]MRC Human Immunology Unit, Weatherall Institute of Molecular Medicine, University of Oxford, Oxford, United Kingdom; and [5]Laboratory of Interdisciplinary Physics, University Grenoble Alpes-CNRS, Grenoble, France

*Correspondence: rrichter@cicbiomagune.es

SUPPORTING FIGURES

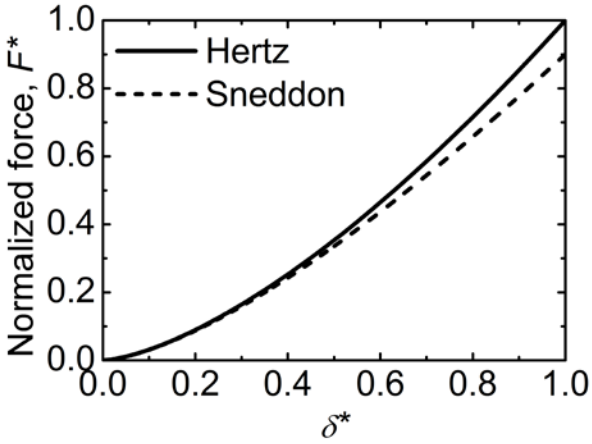

Figure S1. Comparison of the Hertz model (*solid line*) (1) with the Sneddon model (*dashed line*) (2). The latter is more accurate at large indentation, because it properly considers sample deformation (3). Predictions are shown in terms of normalized force, $F^* = F/(4R^2E/3(1-\mu^2))$, *vs.* normalized indentation, $\delta^* = \delta/R > 0$. At any given indentation and fixed Young's modulus, the Hertz model overestimates the force, and this effect increases with δ approaching R. However, the discrepancy between the two models remains small, i.e. below 10%, for all $\delta \leq R$.

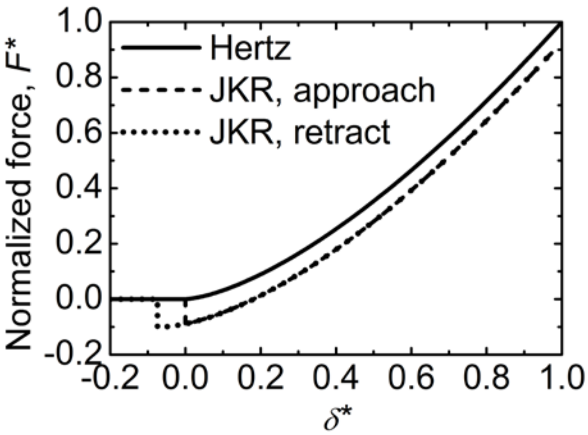

Figure S2. Comparison of the Hertz model (*solid line*; approach and retract curves are identical) with the Johnson-Kendall-Roberts (JKR) model (approach curve - *dashed line,* retract curve - *dotted line*) (4) which includes the effect of adhesion forces (5). Predictions are shown in terms of normalized force F^* *vs.* normalized distance from contact point at approach δ^*, assuming a normalized adhesion force of $F^*_{ad} = 0.1$. In the presence of adhesion, a jump in the force curve at negative indentation is expected. This feature was found in the experimental retract curves but not in the approach curves (Fig. 1*C*), indicating that adhesion established gradually as the colloidal probe indented the sample. The Hertz model therefore is expected to provide a reliable measure of the Young's modulus at small indentations (where adhesion is weak) and to underestimate the elastic modulus *E*' at large indentations (where adhesion is sizeable). The magnitude of the adhesion force observed in our experimental retract curves was typically smaller than the magnitude of the compression force at largest indentation. Based on a numerical comparison of Hertz model and JKR model, one can show that, under this condition, *E*' is underestimated by less than 43%.

SUPPORTING REFERENCES

1. Hertz, H. 1881. Ueber die Berührung fester elastischer Körper. J. Reine Angew. Math. 92:156-171.
2. Sneddon, I. N. 1965. The relation between load and penetration in the axisymmetric boussinesq problem for a punch of arbitrary profile. Int. J. Eng. Sci. 3:47-57.
3. Cappella, B., and G. Dietler. 1999. Force-distance curves by atomic force microscopy. Surf. Sci. Rep. 34:1-104.
4. Butt, H.-J., B. Cappella, and M. Kappl. 2005. Force measurements with the atomic force microscope: Technique, interpretation and applications. Surf. Sci. Rep. 59:1-152.
5. Johnson, K. L., K. Kendall, and A. D. Roberts. 1971. Surface Energy and the Contact of Elastic Solids. Proc. R. Soc. London, Ser. A 324:301-313.