OPEN Author Correction: Probing nanomechanical responses of cell membranes

Jichul Kim

Published online: 14 January 2021

Correction to: *Scientific Reports* <https://doi.org/10.1038/s41598-020-59030-2>, published online 10 February 2020

The original version of this Article contained errors.

In the Results section under subheading ‘Mathematical model of nanomechanical lipid bilayers: comparison between measurements and calculations’,

“The surface tension (σ) is a function of the area strain (α) of the membrane ($\alpha = (A - A_0)/A_0$) with a resting area of A_0 , and the function integration of σ with respect to α gives the surface strain energy density.”

now reads:

“The surface tension (σ) is the function of the area strain of the membrane $\alpha = \frac{(A^{res} - A_0^{res})}{A_0^{res}} = \frac{(\phi_0^{res} - \phi^{res})}{\phi^{res}}$ where A^{res} is the area of the lipid membrane reservoir determined by r_{cr} – r_{ct} , Ω , and r_{cb} (see the next paragraph and Fig. S3 in Supplementary Information online); A_0^{res} is the area of the lipid reservoir at the resting reference configuration; ϕ^{res} is the uniform lipid number density; and ϕ_0^{res} is ϕ^{res} at the resting reference configuration. The function integration of σ with respect to α gives the surface strain energy density.”

In the Methods section under subheading ‘Finite element modeling for lipid membranes’,

“The vesicle area strain is $\alpha = (A - A_0)/A_0 = (\phi_0 - \phi)/\phi$ with resting (i.e., initial) area A_0 or initial lipid density ϕ_0 .”

now reads:

“The vesicle area strain is $\alpha = \frac{(A^{res} - A_0^{res})}{A_0^{res}} = \frac{(\phi_0^{res} - \phi^{res})}{\phi^{res}}$ where A^{res} is the area of the vesicle membrane determined by r_{vc} , Ω , and r_{cb} (see Fig. S3 in Supplementary Information online); A_0^{res} is the resting reference area of the vesicle in the spherical configuration; ϕ^{res} is the uniform lipid number density; and ϕ_0^{res} is ϕ^{res} at the resting reference configuration.”

$$G_a = \int_{\Omega_a} \begin{bmatrix} \hat{A} \\ \hat{B} \\ \hat{C} \\ \hat{D} \\ \hat{E} \end{bmatrix} \begin{bmatrix} N_{ss}(s)_a \sin \theta_a \\ N_s(s)_a \sin \theta_a \\ N_{ss}(s)_a \cos \theta_a \\ N_s(s)_a \cos \theta_a \\ N(s)_a \cos \theta_a \end{bmatrix} ds = 0 \quad (16)$$

now reads:

$$G_a = \int_{\Omega_a} \begin{bmatrix} \hat{A} \\ \hat{B} \\ \hat{C} \\ \hat{D} \\ \hat{E} \end{bmatrix}^T \begin{bmatrix} N_{ss}(s)_a \sin \theta_a \\ N_s(s)_a \sin \theta_a \\ N_{ss}(s)_a \cos \theta_a \\ N_s(s)_a \cos \theta_a \\ N(s)_a \cos \theta_a \end{bmatrix} ds = 0 \quad (16)$$

“For this purpose, a symmetric and positive-definite Jacobian matrix $\bar{J}$ of the residual vector $\bar{G}$ is defined as follows:”

now reads:

“For this purpose, the Jacobian matrix $\bar{J}$ of the residual vector $\bar{G}$ is defined as follows:”

“Based on a general pursuit of finer elements in the methods, terms of G_a associated with the membrane area strain α i.e., T_α (see Appendix A in Supplementary Information online) are assumed to be constant values, which provides great simplicity for expanding Eq. (19).”

now reads:

“By assuming the infinitesimal lateral oscillation of the membrane area (also see next paragraph), T_α (see Appendix A in Supplementary Information online) is assumed to be constant in expanding Eq. (19), which provides great simplicity.”

“Finally, by substituting an initial guess for the solutions $\bar{d}_0$ (i.e. $d_1, d_2, \dots, d_n$ and λ) to the Jacobian matrix $\bar{J}$ and the residual vector $\bar{G}$, the solution vector $\bar{d}$ for $j+1^{\text{th}}$ Newton's iteration can be calculated from $\bar{d}_{j+1} = \bar{d}_j + \bar{J}(\bar{d}_j)^{-1} \cdot \bar{G}(\bar{d}_j)$.

now reads:

“Finally, by substituting an initial guess for the solutions $\bar{d}_0$ (i.e. $d_1, d_2, \dots, d_n$ and λ) to the Jacobian matrix $\bar{J}$ and the residual vector $\bar{G}$, the solution vector $\bar{d}$ for $j+1^{\text{th}}$ Newton's iteration can be calculated from $\bar{d}_{j+1} = \bar{d}_j - \bar{J}(\bar{d}_j)^{-1} \bar{G}(\bar{d}_j)$ ”

“With given boundary values, this iterative process is continued until the difference of two subsequent solution vectors converges to a certain tolerance.”

now reads:

“With given boundary values, this iterative process is continued until the Euclidean norm of the difference of two subsequent solution vectors converges to a certain tolerance.”

These errors have now been corrected in the PDF and HTML versions of the Article.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2021