Numerical simulations of tensile tests of red blood cells

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A group of researchers from Japan has examined how the hold position of a red blood cell affects its mechanical characteristics in tensile tests.

The tensile test is the most fundamental type of mechanical test in material science to understand mechanical properties of material of interest. Although the tensile test has also been used in cellular mechanics, large variations were found in experimental data unlike metallic materials. Conventionally, the variations were attributed to sample-to-sample variations as is common in biological studies. Yet the researchers, who have been engaged in tensile tests of cells for many years, experienced difficulties in controlling the hold position of cells under a microscope using a needle and a micropipette, and hypothesized that differences in the hold position yielded the experimental errors.

The researchers reproduced the tensile test of a red blood cell in silico using a particle method that describes the motion of fluid and the structure as the collective behavior of particles. This method allows a fluid-structure interaction analysis with ease compared to other numerical methods such as finite element methods.

The results show significant varitions in the deformed geometry of the red blood cell during the tensile test, as well as variations in strain distribution. Of the hold patterns examined, with an applied strain of 0.8, the misaligned stretch increased the maximum of the first principal strain by 65-85% in comparison to the aligned stretch.

Although it would be ideal to precisely align the hold position with the stretch to gain correct data, this represents a significant practical challenge. A take-home message of this study is that, for the interpretationof RBC tensile test results, we should always bear in mind that tensile test data are significantly affected by the hold position.

More information: Masanori Nakamura et al. Numerical Simulations of Tensile Tests of Red Blood Cells: Effects of the Hold Position, *Micro and Nanosystems* (2016). DOI: 10.2174/1876402908666160105235937

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