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How skin cells protect themselves against mechanical stress

The skin is the largest organ in the human body and serves, among other things, to protect against physical injury. To provide such protection, skin cells must be tightly connected to each other. However, it was long unclear exactly how such mechanical stability is achieved. Researchers at the Max Planck Institute of Biochemistry together with researchers from Stanford University (USA) have now been able to show how mechanical stress is processed at special cell anchoring points known as desmosomes. For this purpose, they developed a miniature device to measure forces across individual proteins within desmosomes. In the study published in *Nature Communications*, they use technology to show how mechanical forces are processed at these anchoring points.

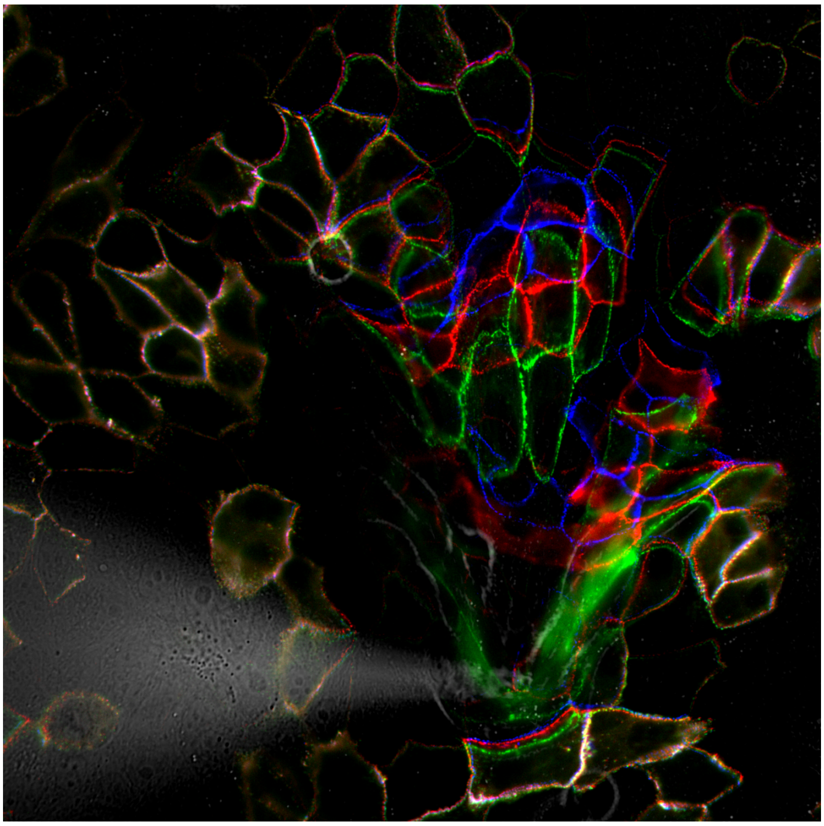
Skin cells cling together

Our skin acts as a protective shield against external factors. To carry out this mechanical function, skin cells form special anchoring points known as desmosomes, which increase the adhesion between cells. It is know that patients with defective desmosomes suffer from severe skin disorders, especially following mechanical stress, but it is still unclear how mechanical forces are processed on the molecular level in desmosomes. An international research group headed by Carsten Grashoff, Research Group Leader at the Max Planck Institute of Biochemistry and Professor at the University of Münster, has developed a new method to investigate the molecular forces at these anchoring points.

Miniature spring scale measures forces in desmosomes

“The technology works similar to a miniature spring scale,” says Anna-Lena Cost, a lead author of the study. The force sensor consists of two fluorescent dyes that are linked by an extensible peptide. The peptide acts as a molecular spring, which stretches in response to just a few piconewtons of force, resulting in fluorescence changes. These changes can be recorded with microscopy methods to determine mechanical differences at desmosomal proteins. In their experiments, the researchers found that desmosomes do not experience mechanical stress, as long no external forces are applied.

When the cells are mechanically stressed, as it is the case in our skin, mechanical forces within desmosomes becomes visible. These forces depend on the strength of the exerted stress and its orientation. “If there is little mechanical stress, other cellular structures are able to bear the load. However, when high levels of stress occur, desmosomes come to the rescue,” summarizes Anna-Lena Cost.



Caption:
The molecular force transduction in desmosomes was analyzed before (blue), during (green), and after (red) the application of mechanical stress.

Original Publication

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About Carsten Grashoff

Carsten Grashoff studied applied sciences at the University of Freiberg from 1997 to 2001. After completing his diploma thesis at the Robert Koch Institute in Berlin, he gained his doctorate in 2007 from Ludwig Maximilian University in Munich. This was followed by a postdoctoral stint at the University of Virginia in the USA. Since 2011, he has headed the independent Molecular Mechanotransduction Research Group at the Max Planck Institute of Biochemistry in Martinsried. In 2014 Grashoff received the Early Career Award of the National Academy of Sciences.

About the Max Planck Institute of Biochemistry

The Max Planck Institute of Biochemistry (MPIB) belongs to the Max Planck Society, an independent, non-profit research organization dedicated to top level basic research. As one of the largest Institutes of the Max Planck Society, 850 employees from 45 nations work here in the field of life sciences. In currently eight departments and about 25 research groups, the scientists contribute to the newest findings in the areas of biochemistry, cell biology, structural biology, biophysics and molecular science. The MPIB in Munich-Martinsried is part of the local life-science-campus where two Max Planck Institutes, a Helmholtz Center, the Gene-Center, several bio-medical faculties of two Munich universities and several biotech-companies are located in close proximity. (http://biochem.mpg.de)

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