Mechanosensitive lysis of single fibrin fibers

C. Martinez-Torres, G.H. Koenderink

Biological Soft Matter Group, AMOLF

Science Park 104 – 1098XG Amsterdam, the Netherlands

Fibrin, the main structural component of blood clots, provides a highly extensible scaffold that stiffens upon deformation, conferring the clot with the mechanical durability it needs to withstand blood flow and tissue remodeling. However, when the clot is no longer needed, the fibrin scaffold needs to rapidly and completely disappear to ensure normal blood circulation. This ‘all-or-nothing’ behavior is a unique property of blood clots, not found in any other biomaterial.

The dissolution of blood clots relies on plasmin, an enzyme that cuts fibrin networks into small soluble fragments. Interestingly, there is strong evidence that mechanical strain regulates this degradation process, with strained networks being more resistant to lysis. Until now, the physical origin of the mechanosensitivity of fibrin lysis is unclear. One possibility is that strain induces changes in the network architecture, hindering access of plasmin and plasmin-activating enzymes. Alternatively, fiber degradation itself may also be mechanosensitive due to mechanically induced changes to fiber or protein structure.

Here, I directly probe the mechanosensitivity of fibrinolysis at the single fiber level. I monitor the lysis of single fibrin fibers under controlled strain/stress using optical tweezers in a microfluidic flow cell, allowing a precise temporal control of plasmin exposure. I show that it is possible to follow the kinetics of plasmin digestion in stressed single fibers, and that this process is tightly regulated by the mechanical strain applied to the fibers.

Corresponding author:

Dr. Cristina Martinez Torres

Biological Soft Matter Group, AMOLF

Science Park 104, 1098XG Amsterdam

the Netherlands

phone: +31 (0)20 754 7241

e-mail: c.martinez@amolf.nl

(I would like to apply for the Outstanding Abstract Award)