Nature's lubricant makes your body a well-oiled machine

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We wouldn’t get very far without lubricin keeping our joints moving. Credit: tableatny/Flickr, CC BY

The old adage goes that the human body is a machine. And in many ways that isn't far from the truth. Like any machine, the human body is made up of many individual parts moving together in a highly coordinated fashion. Parts slide by other parts with every blink and step. And to keep everything running smoothly and undamaged, the machine needs to be well oiled.

Chances are, you have not given much thought to your body's lubrication. And in many ways, this is testament to just how effective it is at protecting against damage and wear. One reason that the sliding surfaces of the body are so resilient is because of a little known protein called lubricin which is nature's most effective "grease".

Lubricin was discovered coating the surfaces of joint cartilage, and is perhaps the body's most effective boundary lubricant. The lubricin molecule consists of two adhesive "feet" flanking either end of a long flexible and non-adhesive "string". It is this dichotomy that is the secret to its effectiveness.

These adhesive feet attach themselves to virtually any surface, forming a loop in the central non-adhesive string. As more and more lubricin attaches to a surface, it self-assembles to form a dense, carpet-like layer of lubricating loops. This layer is known as a "polymer brush", and it cushions surfaces where they contact, reducing friction as they slide.

Proteins ain't proteins

Much of what we know about how lubricin protects joints came from the study of a rare but debilitating genetic disease, camptodactyly-arthropathy-coxa vara-pericarditis syndrome. If you find that to be a mouthful, you can call it CACP.

People afflicted with CACP syndrome suffer a mutation in the lubricin gene that leads to a loss of its lubricating ability. Although at birth the joints of CACP syndrome sufferers show no signs of abnormality and are otherwise healthy, the absence of lubricin's protection quickly leads to joint disfigurement, pain and eventual loss of mobility. Symptoms first appear in children as young as 18 months.

CACP symptoms are similar to those of arthritis sufferers – in fact,

CACP syndrome is often misdiagnosed as early onset rheumatoid arthritis – and this led researchers to investigate the possible link between lubricin and arthritis pathology.

It's now known that arthritic joints contain considerably less lubricin than healthy ones. However, recent discoveries have also found that the concentration of lubricin in joints drop considerably following an injury and remains abnormally low for as much as a year post trauma. This drop in lubricin levels may shed light on the strong causal link between osteoarthritis development and a history of joint injury.

We now believe that these reduced lubricin levels in arthritic and injured joints contributes to both the onset and degenerative nature of osteoarthritis disease, against which there are few effective treatment options. Fortunately, recent animal studies indicate supplementing injured joints with injections of lubricin can be an effective treatment for preventing osteoarthritis development. It does this by reducing wear and tear to cartilage and the death of cartilage cells, which is a major osteoarthritis risk factor, during the critical healing period.

Sight for sore eyes

Although long associated with joints, we are now finding lubricin in some unexpected places, such as the eye. It appears that lubricin is a lubricating component of tears and provides the similar protection to cornea surfaces as it does to joints.

The company Lubris Biopharma is currently conducting clinical trials on a new lubricin treatment for dry eye syndrome.

This syndrome affects millions of people worldwide and is a particularly difficult problem to treat. This is because the eye's natural cleaning process tends to quickly rinse traditional lubricating molecules into the

tear ducts. As a result, eye drops need to be administered frequently, often hourly.

Since lubricin adheres so strongly to surfaces, it is very difficult for the eye to remove it from the cornea surface, allowing a single drop to provide a full day's worth of relief.

Lube job

In addition to medical therapies, lubricin's self-assembling and non-stick properties are promising to usher in significant advances in microfluidic based lab-on-a-chip technologies, which are being developed to diagnose diseases such as cancer, AIDS and Ebola.

The unwanted adhesion of antibodies and other biomarkers to the surfaces of these devices is a major source of "noise" and a persistent obstacle to maximising the diagnostic sensitivity. Recent research shows that lubricin anti-adhesive coatings rival the current best technologies, and it can be applied to any substrate material without costly and difficult surface pretreatments or grafting chemistries.

Lubricin coatings thus offer better performance and greater functionality without significant increases in manufacturing costs. As researchers continue to assimilate the body's slick lessons in lubrication, the possibilities and applications of lubricin will surely grow ever wider.

We might not often think about our body's lubrication system or lubricin. But a deeper understanding of this remarkable protein is helping us treat diseases and produce new therapeutics to help keep us working as a well oiled machine.

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