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BASIC RESEARCH

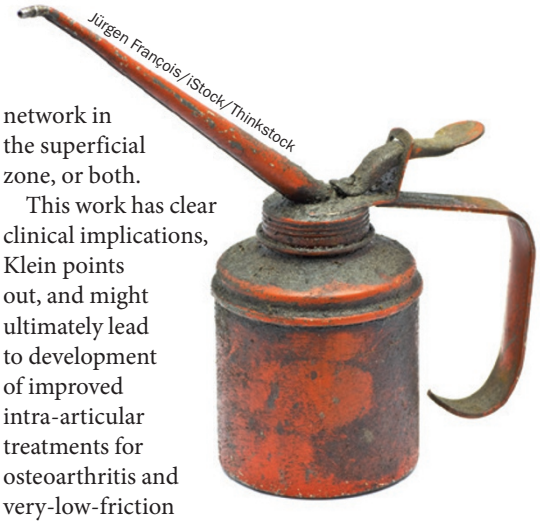
Synovial surfaces use synergy to slide

Up to now, studies of key cartilage and synovial fluid components (namely hyaluronan, phospholipids and lubricin) have never been able to replicate the incredibly low coefficient of friction ($\mu = 0.001$) of healthy cartilage, especially at the high pressures (≤100 atmospheres) occurring in synovial joints. New observations reported by Jacob Klein and colleagues shed fresh light on these ultra-low-friction characteristics. "Our most significant findings were that hyaluronan and phospholipids complex together to yield a very efficient boundary lubricant," notes Klein, "and that all three molecules act synergistically, each with a different role, to provide the extreme lubricity of the cartilage surface."

As friction measurements in synovial joints *in vivo* cannot yield reliable molecular-level information, the researchers used a model system in which relevant molecules were bound to atomically smooth mica surfaces, and frictional forces were accurately measured using a state-of-the-art technique, the surface force balance.

The team's prior work had shown that the phosphocholine head groups of phosphatidylcholine lipids are highly hydrated and can provide lubricious boundary layers. The current study shows that surface-bound hyaluronan attaches to phosphatidylcholine lipids in a manner that leaves these head groups exposed.

"Our big surprise came when we discovered that phosphatidylcholine lipids did indeed complex with hyaluronan and in particular that such complexes provided extremely good lubrication—comparable to that of healthy cartilage," states Klein. In their report the researchers speculate that binding of hyaluronan to the cartilage surface involves either its known interactions with lubricin (which is known to be present in the outer superficial zone of cartilage), or entanglement of its linear, flexible, polysaccharide chains with collagen or other components of the microfibrillar network in the superficial zone, or both.



This work has clear clinical implications, Klein points out, and might ultimately lead to development of improved intra-articular treatments for osteoarthritis and very-low-friction implant materials.

"We are now in the *in vivo* phase of experiments," Klein says, "and are confident that they will lead, hopefully in a short time, to clinical applications."

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Original article Seror, J. *et al*. Supramolecular synergy in the boundary lubrication of synovial joints. *Nat. Commun.* **6**, 6497 (2015)