

Comment on “Hydrostatic Pressurization and Depletion of Trapped Lubricant Pool During Creep Contact of a Rippled Indenter Against a Biphasic Articular Cartilage Layer”, [Stoltz, M. A., Basalo I. M., and Ateshian, G. A., 2003, *J. Biomech. Eng.* 125, pp. 585–593.]

In the Conclusion section of the above article its authors wrote, “. . . contrary to the weeping hypothesis, however, the current analysis demonstrates that [after load is applied] lubricant fluid trapped between a rigid impermeable surface and a porous-permeable cartilage layer flows monotonically into the cartilage during contact creep; no fluid flow from the cartilage into the lubricant pool is observed . . . [T]his result is in better agreement with the premise of the boosted lubrication theory of Walker et al. [1]”

The article gives the duration of “contact creep” as .4 seconds for roughness similar to that of cartilage [2] and about 10 seconds for roughness 5 times as tall and 10 times longer in wavelength.

But the low friction of cartilage continues on for minutes [3]. (The article’s use of a logarithmic scale for time makes contact creep appear to last for a substantial fraction of the interval of low friction.)

For the long period of low friction there is an obvious explanation. Once high spots on the rubbing surfaces (perhaps fringed with “brush borders” of polymer chains) start carrying some of the load fluid from within the cartilage flows into the space between the surfaces and largely makes up for fluid that leaves the loaded region by flowing between the surfaces like a watermelon seed expelled from between thumb and forefingers. This weeping flow keeps the hydrostatic pressure between the surfaces high and friction correspondingly low for a long time. Were it not present cartilage would be, in effect, an impervious bearing with a rough surface, and low friction would last a very short time after load was applied.

References

- [1] Walker, P. S., Dowson, D., Longfield, M. D., and Wright, V., 1968, “‘Boosted Lubrication’ in Synovial Joints by Fluid Entrapment and Enrichment,” *Ann. Rheum. Dis.*, **27**, pp. 512–560.
- [2] McCutchen, C. W., 1980, “Joint Lubrication,” In: *Biology of Articular Cartilage in Health and Disease*, Proceedings of the Second Munich Symposium of Biology of Connective Tissue, July 23–24, 1979.
- [3] McCutchen, C. W., 1962, “The Frictional Properties of Animal Joints,” *Wear*, **5**, 1–17.