

Joint activity and the tribological rehydration of cartilage: moving towards a better understanding of joint biomechanics and health

Christopher Price, Ph.D.

University of Delaware

Osteoarthritis has traditionally been considered a disease of ‘wear and tear’; thus, many individuals, professional and lay alike, harbor concerns that even moderate exercise can be detrimental to joint health. However, epidemiological evidence indicates that far from harming joint health, moderate physical exercise can benefit joint longevity and reduce osteoarthritic disease risk. Despite growing clinical evidence, an explanation for these ‘counterintuitive’ observations and for cartilage’s resiliency in the face of millions of articulation cycles annually has remained elusive. Recently, our team, using a new cartilage explant sliding configuration, the convergent stationary contact area (cSCA), has discovered a sliding-driven mechanism for promoting, sustaining, and recovering the biomechanical function and lubrication of cartilage *ex vivo*. We hypothesize that this mechanism, which we term ‘tribological rehydration’, co-opts hydrodynamic forces generated by surface-sliding to competitively drive fluid from a bathing solution into cartilage, thereby restoring and maintaining cartilage hydration and thickness; shielding the extracellular matrix from stress, and reducing friction. We posit that this newly-discovered sliding (i.e. activity)-induced rehydration of cartilage is an important regulator of cartilage biomechanical function, nutrient transport, and mechanobiological outcomes. In this talk I will describe our team’s recent studies using the cSCA testing configuration to uncover the mechanisms underpinning tribological rehydration and to highlight the overwhelming effectiveness of tribological rehydration in enhancing transport in cartilage. I will also describe a recent study that has fundamentally transformed our understanding of how clinically-relevant differences in joint activity patterning may regulate tissue function, and presumably, the biology of articular cartilage. I hope that you leave convinced that the existence of tribological rehydration’s can be uniquely leveraged to explore how sliding-activity effects cartilage function, mechanobiology, and homeostasis; help explain the ‘counterintuitive’ benefits of joint activity on cartilage health; and establish a framework to unify existing theories regarding cartilage function and lubrication.