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Opinion Article: Articular Cartilage: Lamellar-Repulsive Lubrication of Natural Joints by Zenon Pawlak

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Abstract

This monograph attempts to explain a new joint lubrication mechanism with surface active phospholipids as a lubricant. It provides studies of the principles of cartilage (smart material) of biological micro- and Nano tribology.

Keywords: Articular Cartilage, Natural Lubrication, Lamellar-Repulsive Mechanism of Lubrication of Natural Joints.

Abbreviations: SF- Synovial Fluid, SAL- Surface Amorphous Layer, PLs-Phospholipids, AC-Articular Cartilage.

The concepts presented in this monograph "lamellar-electrostatic mechanism" are new and compatible with the discovery of Prof. Brian Hills's hypothesis that lamellar phases of PLs and phospholipid bilayers are lubricants in natural joints. The concept that boundary lubrication in joints was mediated by an active ingredient in Synovial Fluid (SF) was put forward by Jones (1934), Linn and Radin (1968) and Hills (1984). According to Hills and other authors, the Surface Amorphous Layer (SAL) of cartilage contains surface-active phospholipids.

Phosphatidylcholines (over 40%) sphingomyelin (~30%) and phosphatidylethanolamines (~30%) were subsequently identified in the synovial fluid and SAL. This book is focused on the mechanism of natural lubrication by which the Phospholipids (PLs) in Articular Cartilage (AC) act as a lubricant. The physiological function of PLs is unique in preventing solid-solid contact and degradation of the articular surface. With AC, it is particularly important to have a model where PLs adsorbed on the surface of cartilage impart a number of highly desirable properties.

The importance of basic properties of the cartilage such as the surface energy, wettability, pH, surface charge, and amphoteric surface character were determined and turned out to be compatible with some features of joints lubrication. While the principal aim of the book was to provide an understanding of the meaning of the surface-active state (lamellar bodies), the other is to highlight the solid PL bilayers that possess low surface energy at pH ~7.4, when applied to the body. The understanding of AC amphoteric surface will be essential for the effective repair and regeneration of the degraded knee joint. In conclusion, it can be stated that the lamellar-electrostatic lubrication mechanism, a new approach to understanding natural lubrication, is challenging and deserves to be studied. This monograph is intended for advanced undergraduate and graduate medical and biomechanical students and researchers in the area of biomechanics and biological systems.

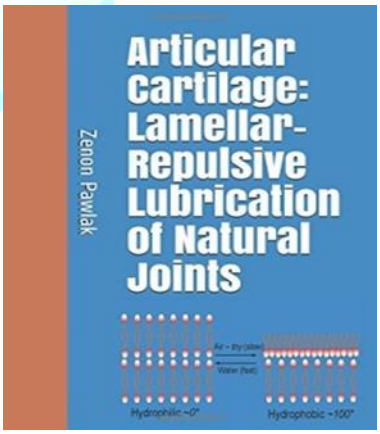

Figure 1: Cover page.

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