

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

Reviewer: Tadeusz Kaldonski *

Affiliation: Department of Tribology, Military University of Technology, Warszawa, Urbanowicza 2, Poland

***Corresponding author:** Kaldonski T. Department of Tribology, Military University of Technology, Warszawa, Urbanowicza 2, Poland, Tel: +48 261 839 743, E-mail: tadeusz.kaldonski@wat.edu.pl

Citation: Kaldonski T. Opinion article: articular cartilage: lamellar-repulsive lubrication of natural joints by zenon pawlak (2018) Edelweiss Appli Sci Tech 2: 278-279

Received: Nov 12, 2018

Accepted: Nov 19, 2018

Published: Nov 23, 2018

Copyright: © 2018 Pawlak Z. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

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.

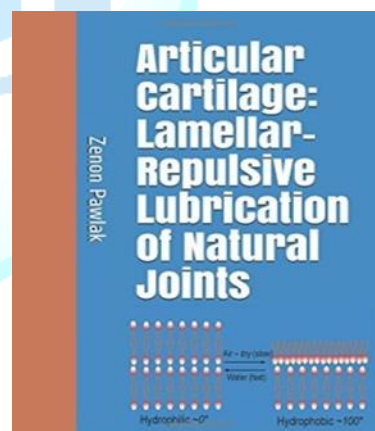


Figure 1: Cover page.



Contents

1.0 Introduction	1
2.0 The structure, composition and function of cartilage	5
2.1 Synovial fluid	11
2.2 Phospholipid bilayers as a potential solid lubricant	17
2.3 Phospholipids	21
2.4 Cartilage and antiphospholipid antibody syndrome	25
3.0 Surface cartilage characteristics	35
3.1 Interfacial energy of PL bilayers	39
3.2 Cartilage surface wettability vs. pH	45
3.3 Friction vs. wettability of cartilage surface	53
3.4 Amphoteric cartilage and its consequences	64
3.5 Cartilage surface charge density vs. pH	75
4.0 Porosity of lubricated cartilage surface	85
5.0 The boundary and boundary-layered lubrication	89
6.0 Lamellar-repulsive mechanism of low friction in Nature	93
7.0 Resurfacing cartilage surface	107
8.0 Articular cartilage restoration and regeneration	123
9.0 Summary and outlook	131
About the Author	137
Bibliography	139
Index	153

References

1. Pawlak Z. Articular Cartilage: Lamellar-Repulsive Lubrication of Natural Joints (2018) Kindle Direct Publishing 161.

