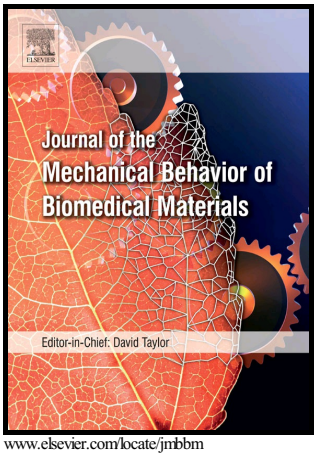
Wear and Friction of UHMWPE-on-PEEK OPTIMA™

Raelene M. Cowie, Adam Briscoe, John Fisher, Louise M. Jennings



www.elsevier.com/locate/jmbbm

PII: S1751-6161(18)31059-2
DOI: https://doi.org/10.1016/j.jmbbm.2018.09.021
Reference: JMBBM2986

To appear in: *Journal of the Mechanical Behavior of Biomedical Materials*

Received date: 17 July 2018
Revised date: 11 September 2018
Accepted date: 17 September 2018

Cite this article as: Raelene M. Cowie, Adam Briscoe, John Fisher and Louise M. Jennings, Wear and Friction of UHMWPE-on-PEEK OPTIMA™, *Journal of the Mechanical Behavior of Biomedical Materials,* https://doi.org/10.1016/j.jmbbm.2018.09.021

Research Paper

Title

Wear and Friction of UHMWPE-on-PEEK OPTIMA™

Authors

Raelene M Cowie[1], Adam Briscoe[2], John Fisher[1], Louise M Jennings[1]

[1] Institute of Medical and Biological Engineering, University of Leeds, Leeds. LS2 9JT.

[2] Invibio Ltd. Thornton Cleveleys, Lancashire. FY5 4QD.

Corresponding Author

Louise Jennings: l.m.jennings@leeds.ac.uk; Institute of Medical and Biological Engineering, University of Leeds, Leeds. LS2 9JT.

Abstract

PEEK-OPTIMA™ is being considered as an alternative bearing material to cobalt chrome in the femoral component of total knee replacement to provide a metal-free implant. The aim of this study was to investigate the influence of lubricant temperature (standard rig running and elevated temperature (~36°C)) on the wear of a UHMWPE-on-PEEK OPTIMA™ bearing couple using different lubricant protein concentrations (0, 2, 5, 25 and 90% bovine serum) in a simple geometry pin-on-plate configuration. Friction was also investigated under a single temperature condition for different lubricant protein concentrations. The studies were repeated for UHMWPE-on-cobalt chrome in order to compare relationships with temperature (wear only) and lubricant protein concentration (wear and friction).

In low lubricant protein concentrations (≤ 5%) there was no influence of temperature on the wear factors of UHMWPE-on-PEEK. With 25% bovine serum, the wear factor of UHMWPE-on-PEEK reduced by half at elevated temperature. When tested in high protein concentration (90% serum), there was no influence of temperature on the wear factor of UHMWPE-on-PEEK. These temperature dependencies were not the same for UHMWPE-on-cobalt chrome.

For both material combinations, there was a trend of decreasing friction with increasing protein concentration once protein was present in the lubricant.

This study has shown the importance of the selection of appropriate test conditions when investigating the wear and friction of different materials, in order to minimise test artefacts such as polymer transfer, and protein precipitation and deposition.

Key Words

Arthroplasty, PEEK-OPTIMA™, UHMWPE, Wear, Friction, TKR