COMMENTARY ON:

PEEK-OPTIMA™ as an Alternative to Cobalt Chrome in the Femoral Component of Total Knee Replacement : A Preliminary Study

COMMENTARY AUTHOR: Adam Briscoe, PhD – Invibio Biomaterial Solutions

AUTHORS OF ORIGINAL PAPER: Raelene M Cowie PhD, Dr Adam Briscoe PhD, Prof Dr John Fisher PhD CEng FIMechE CSci FIPEM FREng CBE and Louise M Jennings PhD CEng FIMechE

JOURNAL: Proceedings of the Institution of Mechanical Engineers Part H: Journal of Engineering in Medicine, 2016 Nov; 230(11): 1008–1015. Published online 2016 Sep 16. doi: 10.1177/0954411916667410

LEVEL OF EVIDENCE: Peer Reviewed, Pre-clinical, *In-vitro* Study

Summary

In order to demonstrate the suitability of a bearing solution in total joint replacements, experimental wear simulation testing *in vitro* is considered the norm. ISO 14243 provides a gait profile for standard testing methodologies in the dynamic simulation of a knee prosthesis. It has recently been shown that this standard may not represent a worst case when analyzing these components. Several research groups have begun to examine how this standard can be improved upon. Previous work from the University of Leeds has shown that by increasing the anterior-posterior (AP) displacement during testing, some prostheses may also display a dramatic increase in the amount of observed wear.

This paper compares the wear performance of a total knee replacement (TKR) with a novel PEEK-OPTIMA polymer femoral component to that of an identical bearing design made from cobalt chrome (CoCr) alloy. Initial testing was carried out under standardized conditions (intermediate kinematics) and, after three million cycles, testing was continued under high kinematic conditions to a total of six million cycles.

The gravimetric results from this study showed that both CoCr (metallic) and PEEK-OPTIMA components produced statistically similar quantities of wear under both intermediate and high displacements. There was little change in the wear when changing the level of AP displacement. In all scenarios the amount of wear measured was low when compared to current alternative TKR designs. Figure 1 shows the comparison between the wear rate under intermediate kinematics for both CoCr and PEEK-OPTIMA femoral components and a comparison with a referenced data point of a current TKR femoral component brand, from the literature, under the same conditions.[1]

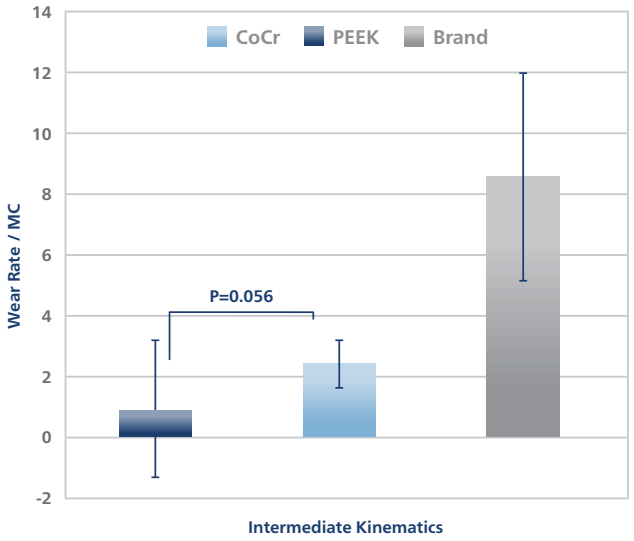

Fig. 1: Comparative volumetric wear rate between a CoCr knee, PEEK-OPTIMA knee and a current TKR femoral component brand.[1]

Key Findings

Based on this intermediate and high kinematic knee gait simulation wear test, there is no statistically significant difference in tibio-femoral wear produced between CoCr or PEEK-OPTIMA femoral components with the same bearing geometry.

Commentary

This paper provides a useful insight into the effects of a revolutionary change of biomaterial for one of the two most commonly replaced joints. A first look at the wear performance of a PEEK-OPTIMA polymer on Ultra-high-molecular-weight polyethylene (UHMWPE) TKR indicates that it can be potentially used as an alternative to CoCr alloy for the development of these types of devices.

Additional mechanical tests have now been performed to establish pre-clinical safety and suitability for the device to be used in a clinical setting. ▲

ABOUT THE AUTHOR

Adam Briscoe, PhD

Dr Adam Briscoe is the Technology Manager for Orthopedics at Invibio Biomaterial Solutions. He has more than 15 years of experience working in research and development for orthopedic medical devices. In 2007, he received a PhD in biomechanical engineering from the University of Southampton, in the United Kingdom. Since April 2017, he has been a visiting research fellow at the University of Leeds, in the United Kingdom, focused on tribology research.

REFERENCE

1. A. L. Galvin, et al. Effect of conformity and contact stress on wear in fixed-bearing total knee prostheses. J Biomech. 2009 Aug 25;42(12):1898-902.

Invibio
BIOMATERIAL SOLUTIONS

Invibio Ltd.
Victrex Technology Centre
Hillhouse International
Thornton-Cleveleys
Lancashire
FY5 4QD, UK

Tel: +44 (0) 1253 898 000
FAX: +44 (0) 1253 898 001

Invibio Inc.
300 Conshohocken State Road
West Conshohocken, PA
19428
USA

Toll Free: 866-INVIBIO (468-4246)
Tel: (484) 342-6004
Fax: (484) 342-6005

For further information please email us at info@invibio.com or visit our website at:

Invibio.com